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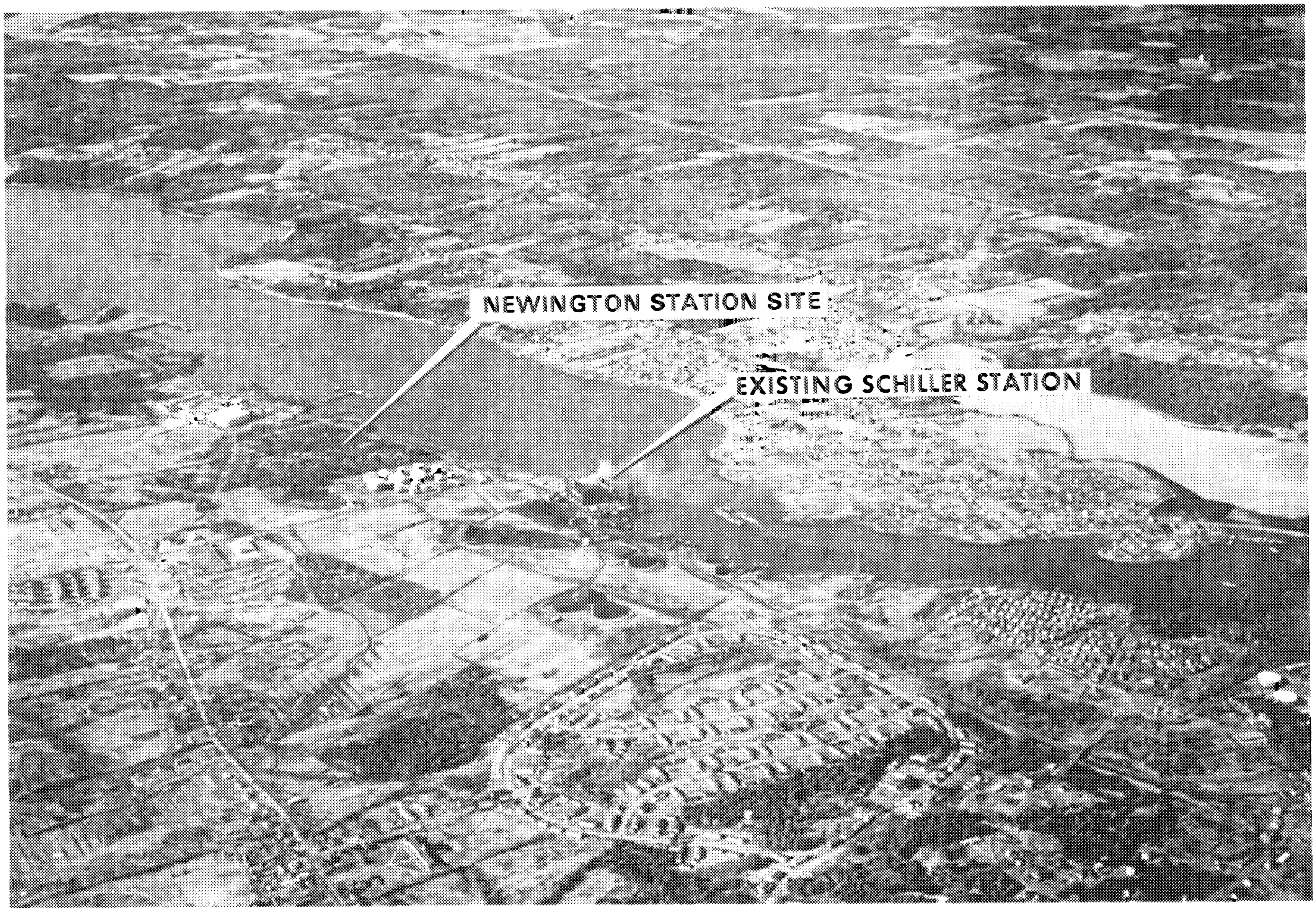
FINAL
ENVIRONMENTAL STATEMENT

NEWINGTON GENERATING STATION
UNIT NO. 1
NEWINGTON, NEW HAMPSHIRE

BASIC INFORMATION USED IN THE
PREPARATION OF THIS STATEMENT
WAS SUPPLIED BY THE PUBLIC
SERVICE COMPANY OF NEW HAMPSHIRE

Prepared by
U. S. ARMY ENGINEER DIVISION, NEW ENGLAND, WALTHAM, MASSACHUSETTS

SEPTEMBER 1972



Piscataqua River looking northwest April 1965 showing
Newington Station site prior to construction

Summary Sheet

Newington Generating Station
Unit No. 1
Newington, New Hampshire

( ) Draft (X) Final Environmental Statement

Responsible Office: U. S. Army Engineer Division, New England, Waltham, Massachusetts.

1. Name of Action: (X) Administrative ( ) Legislative

2. Description of Action: Construction of Newington Station Unit No. 1, a 400 MW oil-fired fossil fuel electric generating station, located on the Piscataqua River, Newington, New Hampshire. Construction of 345KV and 115KV switch-yards; 410 ft. concrete stack; intake and discharge structures associated with the plant. Dredging and disposal of approximately 23,500 cubic yards of bottom sediment; construction of a cofferdam and its subsequent removal involving an estimated 9,000 cubic yards of dumped fill.

3a. Environmental Impacts: The Newington Generating Station will provide an additional economic, safe and dependable source of electrical energy which should fulfill in part, the increasing demand for electrical power in the New Hampshire Sea Coast area. Ecological changes may result from: thermal addition to the bay-river environs; dredge and fill operations for the circulating water facilities; biocidal action; entrainment and entrapment of plankton and nektonic organisms; discharge of domestic sewage and other station waste including oil, chloride, phosphates, ammonia, chromate, zinc, total dissolved and suspended solids, etc. Other impacts include flyash, boiler and stack washdown effluent; stack and noise emissions; and land usage involving a 54 acre site of which 20 acres will be used for plant operation and 40 acres during construction, and approximately 600 to 700 feet of shoreline for the completed intake and discharge structures. Maximum discharge of 20°FΔT and predicted overall rise of 0.67°F to the estuary.

b. Adverse Environmental Impacts: Long-term effects of the plant operation on the estuarine and marine organisms are not definitely known at this time. The close proximity of Newington Station to the existing Schiller Generating Station and the overlap of their discharge waters may possibly create a thermal blockage or heat shock conditions on migrating fish (e.g. alewife, smelt, coho, and striped bass). Addition of biocides (if approved) singly or in association with other station waste, temperature, etc. may cause significant adverse effects in the immediate area of the two plants. Other effects might involve: uptake of heavy metals or other toxicants by invertebrates in the discharge flume area; increase of potential oil spillage due to increase oil tanker service required by Newington Station; and direct effects including entrainment and entrapment of plankton organisms to an unknown extent. Of special concern is the effect on larval and juvenile anadromous fishes, and possible destruction or damage to some during passage through the cooling system. Temporary local increase in turbidity and siltation due to dredge-fill operations. Alteration of 3 acres of intertidal-subtidal habitat and destruction and redistribution of benthic population associated with dredging, blasting, filling, etc. Change in benthic populations within or adjacent to discharge flume. Another possible adverse effect is associated with re-intake of planktonic and nektonic organisms washed from the traveling screens and or their being carried directly into the discharge flume.

4. Alternatives: Alternate methods of generating (5 methods); rational for plant design and subsequent selection of the operational site; alternatives to use of biocides and other mitigation measures are discussed.

5. Comments Requested:

U. S. Department of Commerce
National Marine Fisheries Service
U. S. Department of Interior
Bureau of Sport Fisheries & Wildlife
Bureau of Outdoor Recreation
U. S. Geological Survey
Federal Water Quality Office, EPA
U. S. Coast Guard
Maine Dept. Sea and Shore Fisheries
State of Maine Environmental Improvement Comm.
New Hampshire Fish and Game Dept.
New Hampshire Natural Resource Council
New Hampshire Water Supply and Pollution Control Comm.
New Hampshire Air Pollution Control Comm.
New Hampshire Office of State Planning
New Hampshire Recreation and Park Soc.
Audubon Society of New Hampshire
Sea Coast Anti-Pollution League
Piscataqua Watershed Assoc.
Univ. New Hampshire Institute Natural and Environ. Res. (Res. Develop. Center)
Jackson Estuarine Lab., UNH
Sierra Club
Town of Newington, N. H.
City of Portsmouth, N. H.
Town of Eliot, Maine
Town of Kittery, Maine

6. Draft Statement on file with CEQ 22 May 1972.
Final Statement on file with CEQ ____________.

SUMMARY OF CONDITIONS FOR PERMIT APPROVAL

The Corps of Engineers, New England Division, after weighing the numerous comments and recommendations submitted by reviewing agencies and on the basis of the evaluation and analysis brought forth in the Draft Environmental Impact Statement and reiterated in this Final Statement recommends issuance of a 403 construction permit for Newington Station Unit No. 1. The construction license will be subject to the following conditions for protection of the environment:

(a) The intake velocity (at the traveling screens) will be restricted to 0. 5 fps maximum at mean low water (MLW). However, if a problem results of impingement of fishes and other organisms on the traveling screens, remedial action shall be initiated by the Applicant after consultation with the appropriate Federal and State Agencies to reduce the intake velocity or modify the intake structures or a combination of both to alleviate the problem.

(b) The Applicant will develop an oil spillage contingency plan and preventive measures in coordination with the Federal Environmental Protection Agency, U. S. Coast Guard, Corps of Engineers, State and other local groups having direct involvement. Any construction modification to existing docking facilities or installations of special equipment for the prevention of oil spills and their containment will be completed prior to discharge operations. Similarly, the oil spill contingency plan will be delineated and approved by all agencies concerned prior to permit approval for operation.

(c) The Applicant will comply with applicable Federal and State standards which define acceptable sound levels for the area. Any requirements which necessitate additional construction modification beyond that which is proposed by this statement will be coordinated with the Corps.

(d) Blasting operations done in conjunction of the intake-discharge structure construction, will be coordinated with the New Hampshire Division of Inland and Marine Fisheries. The actual work period will be scheduled so as not to conflict with peak migratory periods of anadromous fish as deemed by the aforementioned State Agency.

(e) The Applicant will plan his operations and perform all work necessary to minimize increase in turbidity of the Piscataqua River estuary during required construction activities (blasting, cofferdam fill and removal, dredging, and placement of impervious fill). A steel sheet pile structure dike or baffle will be installed to retain disturbed sediments and prior to blasting and cofferdam construction activities.

(f) The Applicant will provide the Corps with an annual report detailing all study/environmental monitoring program activities for the previous year. This report will be made available on or before the 1st of June and will incorporate: (1) an analysis of all study program results; (2) a presentation monitoring station data; (3) a detailed analysis of any special programs or research; (4) a presentation of overall conclusions regarding existing conditions and detection of significant environmental trends, and recommendations for any modifications in the overall monitoring program.

(g) The environmental monitoring program will be subject to review on an annual basis and any modifications made on the part of authorizing agencies or the Applicant will be reported in writing to the Corps.

Forward

This Final Environmental Impact Statement attempts to evaluate, within limits of available data, the effect(s), of the proposed construction and operation of the Newington Fossil - Fuel Generating Station Unit No. 1 on the Piscataqua River - Great Bay estuarine environment subsequent to the proposed issuance of permits to the Public Service Co. of New Hampshire (applicant). The statement has been prepared by the NED, Corps of Engineers in accordance with the Department of the Army, Office of the Chief of Engineers, regulations on Preparation and Coordination of Environmental Statements, No. P 105-2-507, 3 January 1972 as required by Section 102 (2) (c) of the National Environmental Policy Act of 1969 (NEPA). The applicant submitted an "Environmental Statement Newington Unit No. 1" in late February 1971. The Corps forwarded copies of this report to the appropriate Federal and State agencies with regulatory and/or authorizing responsibilities. Included were the following:

U.S. Bureau of Sport Fisheries & Wildlife

Federal Water Quality Office

Environmental Protection Agency

Bureau of Outdoor Recreation

Maine Department of Sea & Shore Fisheries

State of Maine Environmental Improvement Commission

Ecological data was limited to that incorporated into Public Service Company's Environmental Statement version and the Piscataqua River Ecology Study, Report No. 1, 1970 Baseline Studies by the applicant's ecological consultant, Normandeau Associates, Inc.

Supplementary information was submitted by the applicant to NED in response to those comments received on its environmental report of 1971. Additional information was also gained from various meetings and visits to the Newington Plant site by Corps staff biologist. The Corps of Engineers subsequently prepared a Draft Environmental Impact Statement, Newington Generating Station Unit No. 1, 15 March 1972 which was issued on 24 April 1972. The statement was distributed to those agencies and local citizen groups as indicated in Section 8, Coordination of this report. The formal review period, consisting of 45 days, terminated 8 June 1972. A three-week extension was granted in order to allow receipt of comments from all participating review agencies and conservation groups.

This Final Statement embroids all of the aforementioned writings as well as updated information supplied by the applicant. Report No. 2 containing results of 1971 monitoring studies was not received until mid-August 1972 and unfortunately its contents are still undergoing review. This publication may be obtained from the applicant upon request.

The statement as part of its evaluation responsibility, has centered critically in a detail evaluation of (1) the applicant's proposed plans and facilities for minimizing and controlling any impacts and (2) the adequacy or inadequacies of the applicant's ecological monitoring programs.

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INTRODUCTION

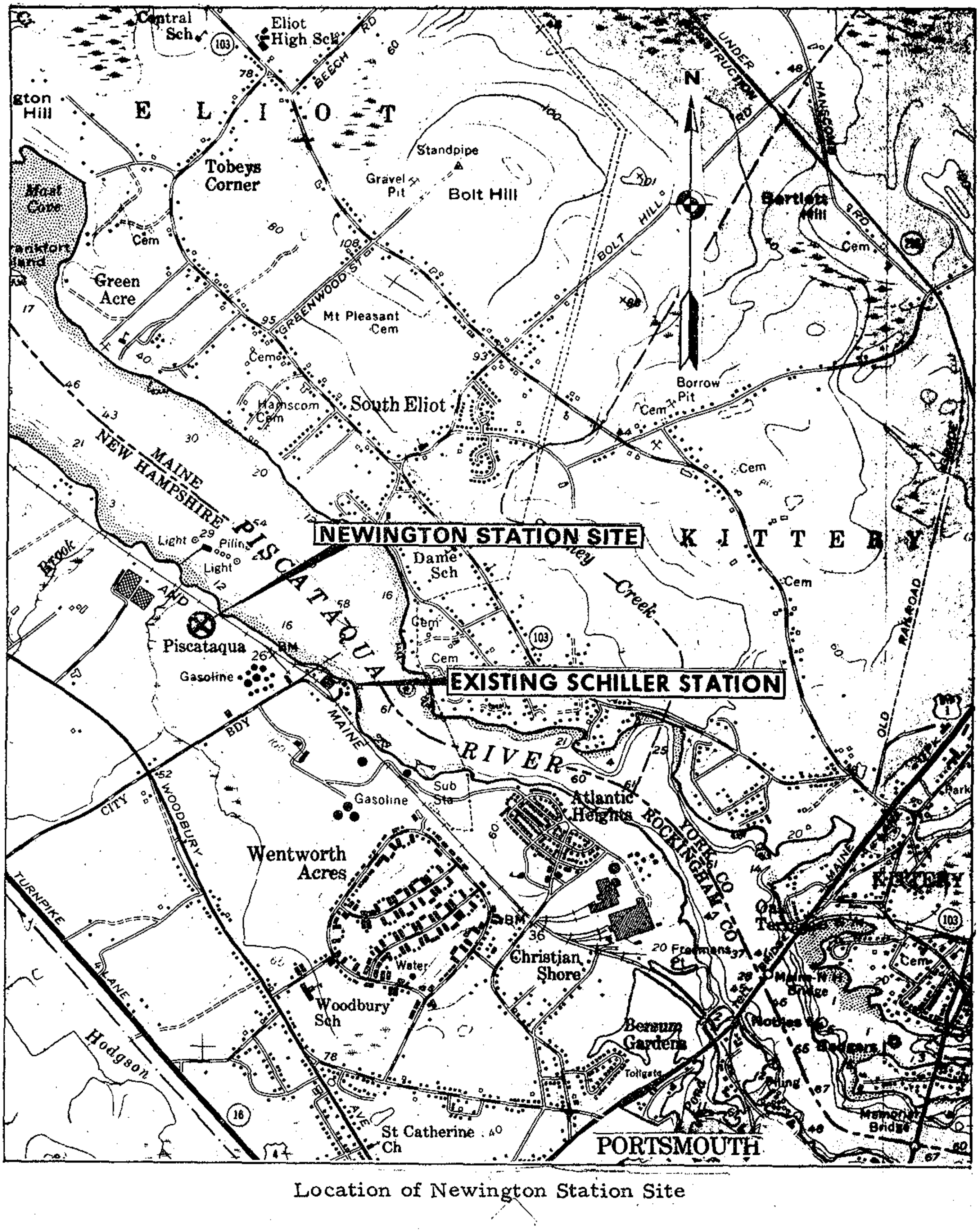
This draft environmental statement was prepared by the New England Division, U. S. Army Corps of Engineers, utilizing the information available to or developed by the applicant, and the results of Corps and other Agency discussions with the applicant.

As the "Lead Federal Agency", it is the Corps' responsibility to prepare the draft and carry out the Corps' requirements for an environmental statement as well as those of the Council on Environmental Quality. In order for the final statement to reflect the areas of expertise or responsibilities of individual agencies, it is paramount that the review of this draft and the comments submitted to the Corps by the Agencies be of a specific nature, relate to their specialty, and in a form that can be incorporated into the final statement as their positive input.

It is the opinion of the Corps and others, including the applicant, that some possible effects of plant operation on estuarine life cannot be reliably predicted at this time. The applicant is aware of this problem and has made arrangements for long-term ecological studies which will relate biological processes and changes to plant operation. For example, while certain tentative conclusions can be made about the effects of thermal effluents on certain shellfish and benthic invertebrates, these relate exclusively to "direct" effects on adult organisms.

Physiological studies of various species are particularly desirable to ascertain the effects on them when passing through the cooling system. It is concluded also, that more information is needed on the migrating patterns of young anadromous fishes such as smelt, alewifes, and salmon, while in the vicinity of the plant on their way to the ocean so that intake design and operation would minimize interference with their annual passage. The significance of the shore-end of the estuary and river for these small fish needs further elucidation. Periods of peak abundancies of fish eggs and larvae also should be delineated.

The Army Corps of Engineers in seeking answers to these questions is presently writing in cooperation with the applicant, a comprehensive outline for expansion of the current environmental sampling and monitoring program initiated by Public Service Co. of New Hampshire. Recommendations will be incorporated into the final environmental statement and serve as condition requirements for permit approval for construction of intake and discharge facilities (Section 10) and water discharge (Section 13, Refuse Act) under the Rivers and Harbors Act of 1899. It is felt that these provisions will provide reasonable assurance to ecological protection regarding the Newington Station project under consideration in this statement.



Location of Newington Station Site

FIG. 1

1. PROJECT DESCRIPTION

A. Site

The proposed electric generating plant, Newington Station, is to be located on the south bank of the Piscataqua River, in the town of Newington, New Hampshire, about 1000 feet northwest of the Portsmouth city boundary. The site is designated as Piscataqua on the U. S. Geological Survey topographic map, Portsmouth Quadrangle (Fig. 1).

The Newington Station is approximately 5.6 miles upstream from Jaffrey Point where the river discharges into the ocean, and 0.2 miles from the neighboring Schiller Steam electric generating station. The river is about 2000 feet wide at the site, with a natural channel 40 to 50 feet deep on the north side, and a gently sloping bottom running out from the plant site to the channel. The 30 foot depth contour on the Station side runs at a distance of about 800 feet from shore.

The Newington Station will be located on a 54 acre site off Gosling Road. Of the 54 acres only 40 acres are planned to be utilized during construction. Upon completion of construction only 20 acres are estimated to be required for plant operation, the remaining 34 acres will be landscaped or allowed to return to their pre-construction state by natural succession. Of the approximately 1400 feet of shoreline associated with this site, no more than 600 feet are to be utilized for construction and permanent use of intake and discharge facilities.

B. Equipment

a. General

The Newington plant will have a nominal capacity of 400 MWe and a maximum heat rejection rate of 2.2×10^9 Btu/hour.

The main facilities of the plant will include a boiler house and turbine hall, precipitator, chimney, an intake structure, a 345KV substation, and a 115KV substation. The approximate dimensions of these are listed below:

	Length (ft.)	Width (ft.)	Height (ft.)
Boiler House	102	125	185
Turbine Hall	200	80	90
Intake Structure	80	50	35
Precipitator	130	50	160
345KV Substation	540	276	-
115KV Substation	100	50	-
Chimney	20'-9" (throat diameter)		410

Also to be associated with these are the administration wing, service shops, auxiliary boiler, and fan rooms, all of which are contiguous to either the turbine hall or boiler house.

b. Planned Operation

This unit is planned to operate as a cycling unit and will be utilized only when the system demand exceeds the capacity of the more efficient base-load units. Therefore, it is expected that this unit will operate during the daylight hours on weekdays (approximately 16 hours) and be shut down nights and weekends. However, the unit will have an average load factor of approximately 75% in its first few years (when the system requires additional base capacity) and is planned to decrease to less than a 50% load factor by the tenth year (when the base load will be carried by units designed for this purpose).

A turbine generator rejects more heat if it operates at 50% load for 100% of the time than if it operates at 100% load for 50% of the time due to inefficiencies. The more conservative figures are tabulated below for the average and peak temperature rises in the estuary considering heat dissipated to the ocean and the atmosphere. In all cases it will take 5.7 days to reach 98% of the ultimate temperature rise.

Load Factor	Average °F	Peak °F
100 %	0.67	0.94
75 %	0.52	0.72
50 %	0.39	0.54

c. Steam Generator

The steam generator or boiler will be an indoor, balanced draft, drum type unit with natural circulation, designed by Combustion Engineering for 1980 psig, 950°F super heat and 950°F reheat outlet steam temperatures and a maximum continuous rating of 3,100,000 lbs. steam/hour. This steam generator will be oil-fired and capable of burning either crude or #6 residual oil. The fuel used however, will have a sulfur content of 1.0%.

Steam generator accessories include two motor driven half capacity forced draft fans and two motor driven half capacity induced draft fans.

d. Turbine Generator

The turbine will be an indoor, condensing, single reheat, tandem compound, two flow, 3600 RPM unit with 31" last stage blades furnished by Westinghouse Electric Corporation. The electric generator will be an indoor 460,000 kva, 0.90 p.f., 3-phase, 60 hertz, 24,000 volt 3600 RPM, hydrogen inner-cooled unit complete with brushless exciter, static exitation and voltage regulators also by Westinghouse Electric Corporation.

The condenser is to be a single shell, single pass, divided waterbox surface condenser arranged with tubes perpendicular to the turbine centerline and will be supplied by Westinghouse Electric Corporation.

C. Circulating Water System

a. General

The circulating water system is necessary to provide cooling water to the condenser. It will be a once through system taking water from the estuary and discharging back to the estuary. The maximum ΔT will be 20° F.

b. Intake

The intake will be from a level low enough to ensure proper suction conditions at the pumps under any tide conditions. The intake velocities at the traveling screens will not exceed 0.5 fps at Mean Low Water (MLW).

The intake structure will include coarse bar racks, stop logs, traveling water screens, wet wells, circulating and primary cooling water pumps, screen wash pumps, hypochlorite injection system and a screen house. The intake substructure will be of concrete, and will be arranged to provide two (2) of the ten (10) coarse bar racks perpendicular to the tidal flow of the estuary thereby providing a means for fish to escape entrapment. Ten sets of stop logs are included and located so as to be able to isolate and de-water each or both of the intakes. Four (4) Link-Belt vertical traveling water screens will be provided, two (2) screens for each intake pump. These screens will be 15'-3" wide (14'-0" net width) by 35'-0' between sprocket centers and with 3/8" square openings between 12 ga. copper wires which form the screen. The screens rotate during cleaning at a speed of 12 f.p.m. They have washing capability that is manually actuated. However, a safety device is included with the screens which will automatically start rotating and washing them at a predetermined head differential. Washings from the screens will be collected in a trough and returned to the estuary.

The screened water will go to a wet-well from which primary cooling water pumps and circulating water pumps draw their water. In this wet-well, a biocide, liquid sodium hypochlorite diluted with water will be introduced into the water. This will be done by an automatic mixing, metering and feeding system which will be used as water/salt water heat exchangers when the pumps normally relied upon for this purpose, the circulating water pumps, are not in use. These heat exchangers carry heat away from the smaller auxiliary equipment (lube oil coolers, air compressors, etc.). The primary cooling water pumps will be vertical, wet pit, two stage, mixed flow, motor driven single speed pumps with a capacity of approximately 400 gpm. The circulating water pumps are Allis-Chalmers vertical,wet pit, mixed flow, single stage, single speed motor driven pumps, 440 RPM, 1370 HP, 89% efficient. They operate at head of 42.5' and have capacities which vary with the tide as listed below:

Normal plant operations with both circulating water pumps operating.

Tidal Stage	Flow	Approach Velocity
Mean High Water	230,000 gpm or 512 cfs	0.34 ft/sec.
Mean Sea Level	226,000 gpm or 504 cfs	0.38 ft/sec.
Mean Low Water	220,000 gpm or 492 cfs	0.44 ft/sec.

Abnormal plant operations with only one circulating water pump operating because of low load or cold intake water temperature.

Tidal Stage	Flow	Approach Velocity
Mean High Water	129,000 gpm or 288 cfs	0.38 ft/sec.
Mean Sea Level	126,000 gpm or 281 cfs	0.43 ft/sec.
Mean Low Water	124,000 gpm or 276 cfs	0.50 ft/sec.

The two circulating water pumps discharge into a single 8' I.D. concrete circulating water pipe which leads to the condenser.

c. Discharge

The discharge from the condenser is also an 8' I.D. reinforced concrete pipe which leads to a weir structure placed and constructed so as to maintain a constant discharge pressure in the discharge pipe unaffected by tidal fluctuations. The outfall of the weir is piped to the discharge structure, which will be located approximately 500 feet downstream of the intake structure, and will be arranged to direct the flow downstream toward the ocean. The discharge structure will consist of a head wall at the termination of the 8' diameter pipe emptying into a short canal which will terminate at a concrete weir controlling the surface discharge of the circulating water. Incorporated into this weir will be the capability of changing the elevation, direction and velocity of the discharge.

d. Construction

In the dredging for construction of the intake and discharge it is estimated that 4000 c.y. of rock will be excavated (this will be used as riprap along the discharge flume and along the fill area adjacent to the structures); 7500 c.y. of inorganic silt will be excavated (this will be disposed of in either of two abandoned gravel pits owned by the Public Service Company of New Hampshire); and 12,000 c.y. of sand and gravel will be excavated (this will be used as fill adjacent to the intake and discharge structures). A temporary cofferdam consisting of 9000 cubic yards of dumped sediment will also be constructed for the purpose of facilitating dredge and fill operations and construction of the intake-discharge structure.

D. Flue Gas System

The boiler is arranged so that the force draft fans blow air into it, where combustion occurs. From this point hot gas exits the boiler via the gas ducts. The gas passes through an eight cell electrostatic precipitator with four electric fields per cell to be supplied by Buell Engineering Company. This precipitator is designed for a gas flow of 2,101,000 ACFM and a maximum gas temperature of 650°F. It is anticipated that the outlet particulate loading from the precipitator will not exceed 0.005 grain/ACFM during operations. Two induced draft fans are in the gas path between the precipitator and the chimney. The chimney is a 410' high reinforced concrete chimney with an independent brick lining. The lining has a 31'-0" I.D. at the base and a 20'-9" I.D. at the throat. During normal operation the flue gas entering the chimney will be 510°F and have a velocity leaving the chimney of approximately 80 f.p.s. The precipitator interior and the chimney lining are designed to have the capability of being washed if required. Provisions have also been included in the precipitator and chimney to allow for sampling the combustion gases.

E. Substation

Associated with the plant will be a 345KV switchyard having width provisions adequate for three electrical bays. Initially, however, the electrical configuration will be such that only a portion of the yard will be used. A control house will be located in this substation. There is also a 115KV substation to provide station service power from the Schiller Station.

F. Noise Attenuation

Newington Station is being designed and constructed with full recognition of the desirability of noise abatement for both personnel within the plant as well as the surrounding community. Provisions for the control of noise have been provided as follows:

Silencers on forced draft fan inlets.
Isolated F.D. fan rooms.
Silencer on power operated safety value vent.
Perforated absorptive plant siding liner.
Isolating shields or walls around various pieces of equipment.
Precautions taken in selecting equipment.

G. Aesthetic Appearance

Although specific regulations for aesthetic appearance do not exist, the Public Service Company of New Hampshire recognized that an electric generating plant does affect the appearance of the environment into which it is placed and, therefore, designed Newington Station to have as pleasing an appearance as possible, compatable with its natural surroundings.

The applicant feels this effort along with landscaping, color schemes and location of various components are commensurate with efforts to minimize any environmental effects from an aesthetic viewpoint.

2. ENVIRONMENTAL SETTING WITHOUT THE PROJECT The description of environmental setting for the Newington Station site must bear cognizance of those many aspects which, in fact, contribute to it. This discussion will concentrate on those aspects believed to be of major importance and interest.

The soils of the site may be described as composed of glacial till of Wisconsinian Age which consist of dense clay and sand with some boulders. Post-glacial marine deposits were laid down over this till during the time immediately after glacial recession when this area was still depressed below sea level. Post-glacial deposits consist of moderately firm to soft, finely laminated clay and fine sand. During the subsequent rise above sea level, the Piscataqua River reworked the top of the marine deposits and deposited fluvial sands and gravels on the surface. The present shoreline is bordered by an area of soft, organically rich mud.

The bedrock at the site is near the interface of the Eliot Formation and the Kittery Formations, both of which consists of phyllites and quartzites of probable Silurian age. The Formations at this location have been metamorphosed to the biotite stage. Bedrock elevations vary from approximately sea level to +10 feet.

Topographically, the site is located in the Seaboard Lowland Section of the New England Physiographic Province. The relief is low and irregular with elevations ranging from sea level up to about +40 feet. The area is generally poorly drained and swampy in places.

The region is drained by the Piscataqua River. The Salmon Falls and Cocheco Rivers flow southward and join to form the Piscataqua River about five miles north of the site. The Bellamy, Oyster and Lamprey Rivers flow south and east, while the Squamscott (Exeter) and Winnicut Rivers flow north into Great Bay and Little Bay which converge with the Piscataqua River about two miles above the site. The Little Bay-Great Bay complex encompasses about 5700 acres at mean-high water and about 2700 acres at mean-low water. The Piscataqua River and all its tributaries are tidal for some distance upstream. Tidal currents are extremely strong (records exist for 7 knots) and turbulent in many parts of the estuary, particularly in the tortuous channels of the Piscataqua River, the constricted regions of Little Bay, and the narrows at Dover, Durham and Adams Points. The current diminishes gradually toward the upper reaches of Great Bay beyond Adams Point. Prevailing semidiurnal tide pattern results in an estuarial circulation best described as well mixed.

A single perennial unnamed stream crosses the site flowing in a northeasterly direction.

Composition of the bottom of the Piscataqua River Estuary is directly affected by the velocity of water movement. The mid-channels of the Piscataqua River and of Little Bay are characterized by rapid currents with numerous rips and eddies, and the rock strewn bottom collects little sediment[1]. However, the bottom in shallower protected areas of the Piscataqua River, shoreward portions of Little Bay, and most of Great Bay is subject to sedimentation and is composed primarily of sand, silt, and

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[1] U.S. Army Corps of Engineers engages in periodic dredging operations to keep the channel open.

large quantities of mud. Until about 1930, the suspended material entering the estuarine system was trapped and held in place by vast beds of eel grass, but with the destruction of the eel grass by disease, the tidal flats have been subject to extensive erosion, resulting in excessive turbidity in the water. The eel grass is presently becoming reestablished, and if this trend continues, turbidity values should slowly decrease.

The site is bordered on the river's edge by two commercial installations. The abutter to the northwest is Simplex Wire and Cable Company who fabricates electrical cables primarily for underwater communications application. To the southeast of the site is a Mobil Oil Corporation tank farm and the Schiller Generating Station (Fig. 3).

Schiller Station is located downstream from the proposed Newington Station on the south bank of the Piscataqua River, in the city of Portsmouth, abutting the same portion of Portsmouth-Newington boundary as the Piscataqua site. The plant site is on a small point of land at a bend in the river, at the upstream end of a section of river, approximately 750 feet wide, 50 feet deep and 3/4 mile long. Immediately upstream from the plant the river widens to about 2,000 feet in the reach facing Newington Station. In this narrow section of the river, the channel essentially occupies the entire cross section of the river but as it widens upstream the channel swings toward the Maine shore while the New Hampshire side has a gently sloping bottom.

The Schiller Station is currently operating four generating units designated 3 to 6 (Units 1 and 2 were mercury units and have been retired). Table I gives heat rejection data for Schiller Station.

TABLE I

Unit	Rating, KWe	Operating Since	Circulating Water Flow GPM	Circulating Water Max. Temp. Rise °F
3	30,000	1950	26,900	17
4	48,000	1953	28,200	20
5	48,000	1955	28,200	20
6	48,000	1958	28,200	20

Total heat rejection rate at full load + 1.07×10^9 Btu/hour.

Schiller Station currently operates primarily as a cycling or peaking plant, which is utilized only when the system demand exceeds the capacity of the more efficient base-load units. The average daily load on weekdays is on the order of 50% capacity. Units are normally shut down or lightly loaded at night and on weekends.

Occasionally, when other units on the system are unavailable, there may be periods of several days at high average load. The applicant has stated that in future years there will be a trend toward further reduction in operation of the existing units as other larger facilities, including the proposed unit at Newington, come into operation.

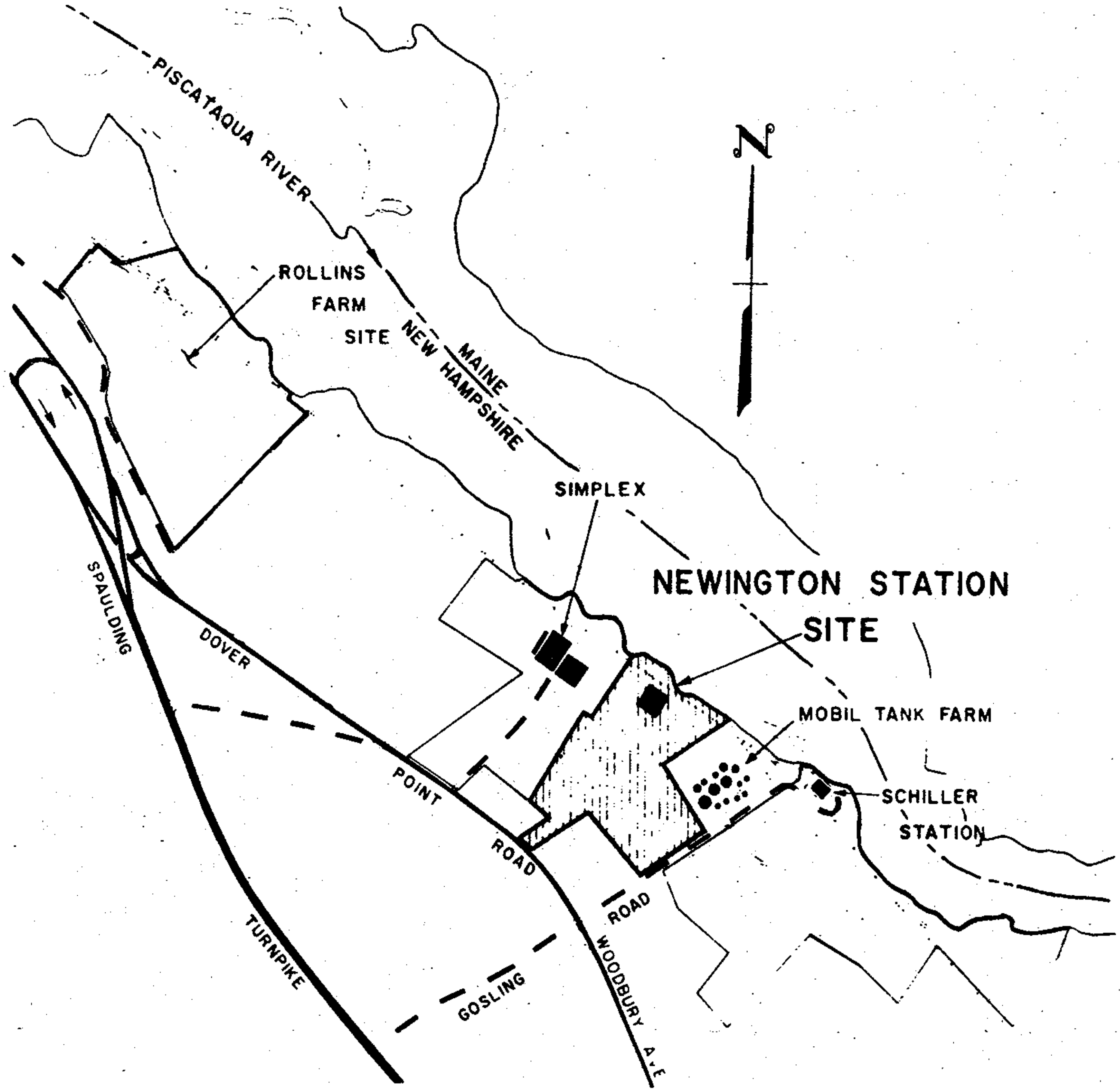
PISCATAQUA RIVER
N
ROLLINS
FARM
SITE
MAINE
NEW HAMPSHIRE
SIMPLEX
NEWINGTON STATION
SITE
MOBIL TANK FARM
SCHILLER
STATION
SPAULDING
DOVER
POINT
ROAD
ROAD
WOODBURY AVE
GOSLING
TURNPIKE

FIG. 3

Non-riparian abutters include an automobile agencv, and a day-schc... retarded children.

A spur of the Boston and Maine Railroad traverses the site area parallel to the river.

Elsewhere along the Piscataqua River within the general area are two petroleum product tank farms, a storage depot for coal and fuel oil, the Schiller Station electrical generating station, gypsum construction materials plant, and several marinas which cater principally to small pleasure boats.

One important commercial utilization of the river is for delivery of raw materials, fuels, etc. by freighters and tankers and for shipping of the finished manufactured product. This type of commercial usage of the river will be unimpeded by plant operation.

The single most important commercial operation (in terms of numbers employed) on the Piscataqua River is the Portsmouth Naval Shipyard at Kittery, Maine. This facility, engaged in the construction and repair of U. S. Navy submarines, is located about 2-1/2 miles seaward of the Newington site. Operation of the Newington Station should have no impact on the activities at the Portsmouth Naval Shipyard.

Some commercial fishing for lobster takes place in the Piscataqua River. The reach of river adjacent to the proposed site is fished by both Maine and New Hampshire lobstermen. Public Service Company, New Hampshire, reports that there appears to be a disproportionate number of lobster pots present in the area receiving warm water from the Schiller Station, and that generally the lobstermen take better than average catches from these pots.

The present recreational utilization of the Great Bay-Piscataqua River complex consists basically of three general activities: fishing, hunting, and pleasure boating. Of these three, fishing is believed to be the major recreational usage based on numbers involved, length of season and the multiplicity of discrete fishing types which involve distinctly different categories of sportsmen.

Historical evidence indicates that the Piscataqua River Estuary was noted for its rich marine life. Salmon, shad, cod, lobsters, clams, and oysters were present in such abundance that they not only supplied the populace with a major supply of seafood, but were even used as food for domestic animals. A noticeable decline in these marine resources occurred after the beginning of local industrial development about 1800. This decline can be traced to destruction of bottom habitat through sedimentation (resulting from logging and the more recent devastation of eel grass beds), exclusion of fish from breeding grounds by dams on the rivers and to domestic and industrial pollution.

The present day sports fishery of Great Bay complex centers around striped bass, coho salmon, flounder, smelt, lobsters, crabs, oysters and clams. Striped bass are fished from May through October. Methods employed are various including live bait, plugs, spinners and flys which are cast, trolled or drifted. Many sportsmen fish from shore or bridges whereas others favor boats. Striper anglers usually concentrate on either the smaller "schoolies" or larger "bulls" with techniques differing for each. Coho salmon were introduced into Great Bay from the west coast in 1969. Subsequent yearly stocking has taken place since then with about 90,000 juvenile fish released each year. It is estimated that 2% (1800 of these released fish) return to spawn with better than 1% (18) of those returning taken by the angler. Coho salmon are sought primarily in the fall when mature fish undertake their spawning run into the bay and thence up into the rivers. Whereas this is a relatively new fishery to this area, no doubt angling techniques are in an experimental stage, varying widely. Flounder, both winter (Pseudopleuronectes americanus) and summer (Liopsetta putnami), are taken in large numbers and although not as highly prized as stripers and coho, are tremendously important especially with younger and less sophisticated fishermen. Smelt are the basis for a substantial winter ice fishing resource. During the months of Januray, February and March, they are taken in substantial numbers in that portion of the upper bay where ice is thick enough to support the angler. Ice houses are used by many and number several hundred during the prime ice-fishing season.

Both oysters and softshelled clams are taken in the Great Bay area. This resource is managed on a sports fishery basis requiring an oyster or clam license. Lobsters and crabs, unlike the molluscan shellfish, are utilized both commercially as well as by sportsmen.

Hunting of waterfowl involves a considerable number of sportsmen during the relatively short season. From about the middle of October to the beginning of January, duck hunters engage in this activity with the black duck and Canada goose being the principal species sought. In addition, bufflehead, scaup, teal, golden eyes, mergansers and mallards may also be taken. Great Bay supports a sizable number of winter resident birds and many more on a transient basis as they layover for indefinite periods of time during their migratory flights. Hunting techniques vary depending on individual sportsmen and the species involved.

Pleasure boating includes both power and sailing craft although sailing is somewhat restricted by strong tidal currents. Associated with power boating is the sport of water skiing which is engaged by a few. In addition to the actual utilization of Great Bay-Piscataqua River waters for pleasure boating, it should be emphasized that this area serves as a suitable location for boat mooring, private boat docks, launch ramps and marinas from which boats may travel to the ocean.

Swimming is not considered to be of significant importance in considering the recreational usage of these waters. Probable reasons for this are the lack of suitable beaches and presence of domestic sewage from adjacent communities. The proximity of excellent coastal bathing beaches, no doubt, influences this situation.

Even though the ecology of the estuary has been substantially altered, it is probable that the area can be brought back to its former condition with reduction in domestic and industrial pollution and careful environmental planning in the future.

Ecological Conditions of the Piscataqua River Estuary

An ecological- biological study was initiated by Normandeau Associates, Inc., Manchester, New Hampshire under contract to the applicant in April, 1970. The studies were designed to determine the kinds of organisms, their distribution and relative abundance in the vicinity of the proposed generating unit.

The following information was extracted from "Report No. 1-1970 Baseline Studies" prepared by Normandeau Associates, Inc. for Public Service Company of New Hampshire. The contents forthwith presented will hopefully serve to describe, within limits of the scope of studies, the existing marine environment of the Piscataqua River Estuary. Many tables and graphs have been omitted for purpose of brevity and only those sections of the report containing results and discussion of investigations are presented. Survey sampling station locations are shown in Figure 4 and described in Table I. Summary and conclusions made by Normandeau Associates, Inc. based on this data are presented under Section 4 of this statement along with the Corp's own assessment.

This information was deemed to be of primary importance in order for reviewing agencies and individuals to render an evaluation of any ecological impact (s).

TABLE I

PISCATAQUA RIVER ECOLOGICAL STUDY - PHASE I

STATION	General Description of Station Locations
1	Black can No. 5, harbor entrance
2	Maine/New Hampshire toll bridge
2A	Memorial Bridge
3	Red Nun Buoy No. 6
4	Northeast of General Sullivan Bridge in channel
5	Black can No. 17 in Piscataqua River
6	Clements Point in Bellamy River
7	In channel between channel markers R-2 and C-3 at Fox Point
8	In Oyster River near mouth of Smith Creek
9	Adams Point in the channel
10	Black can No. 7 in Great Bay
11	Near junction of Lamprey and Squamscott Rivers
12	New Hampshire side at Maine-New Hampshire toll bridge
13	On Maine side in creek west of Maine-New Hampshire toll bridge
14	West of "new" bridge - New Hampshire side
15	Maine side - east of navigation point and high-tension towers
16	In cove east of Schiller Generating Station
17	Maine side at end of Long Reach Farm
18 - 40	Between Schiller Plant and Simplex Pier - Benthic Station locations are 300' offshore LW marsh
18A- 40A*	Benthic station locations are 500' from HW mark
42 - 42A*	On the west side of the Simplex Pier
44 - 44A*	In a large cove west of the Simplex Pier
19	One-half mile east of Frankfort Island
21	In Mast Cove behind Frankfort Island
23	At Adlington Creek
25	On Maine side directly across from the eastern point of the General Sullivan Bridge
46	East of old shipyard and west of Gulf Oil Terminal
48	West of Atlantic Terminal
50	Cove on northeast side of General Sullivan Bridge
52	At Fox Point
52A	Benthic station half way between Red Nun No. 42 and Fox Point
54	Eastern end of Woodman Point

* "A" Stations are located 500' from high water mark, unless otherwise stated.

A. Seasonal Temperature Variations

The Piscataqua River Estuary is characteristic of most temperate estuarine areas in that it exhibits considerably greater seasonal temperature extremes than does the adjacent ocean. Generally, marine and estuarine waters are the same temperature in March, after which the estuary, and particularly Little Bay and Great Bay, warms rapidly (Figures 5 and 6). Three factors contributed to this accelerated warming. Spring runoff from the Piscataqua, Bellamy, Oyster, Lamprey, Squamscott, and Winnicut Rivers (Figure 4) probably accounts for much of the initial warming trend. Radiational heating of exposed mud flats in Great and Little Bays during ebb tide, with subsequent conductive transfer to bay water on incoming tides, provides a second heat source, and the low flushing rate of the entire estuary constitutes the third factor. Dye studies conducted by Webster-Martin, Inc. in September of 1968 indicated that the water exchange rate is approximately 9,000 cfs for the area near the Rollins Farm site in Newington, 15,500 cfs at Newington Station and 17,600 cfs at Schiller station. The total time to replace all water in the area is approximately two days. Complete exchange therefore is not a daily occurrence even in the seaward part of the estuary, but instead water shifts back and forth throughout several tidal cycles. The temperature of water recirculated in this manner tends to rise due to increased insolation.

The estuary remains warmer than the ocean from April until mid-October when temperatures re-equilibrate and, under the influence of surrounding land masses, becomes cooler than the ocean during winter months (Figure 7).

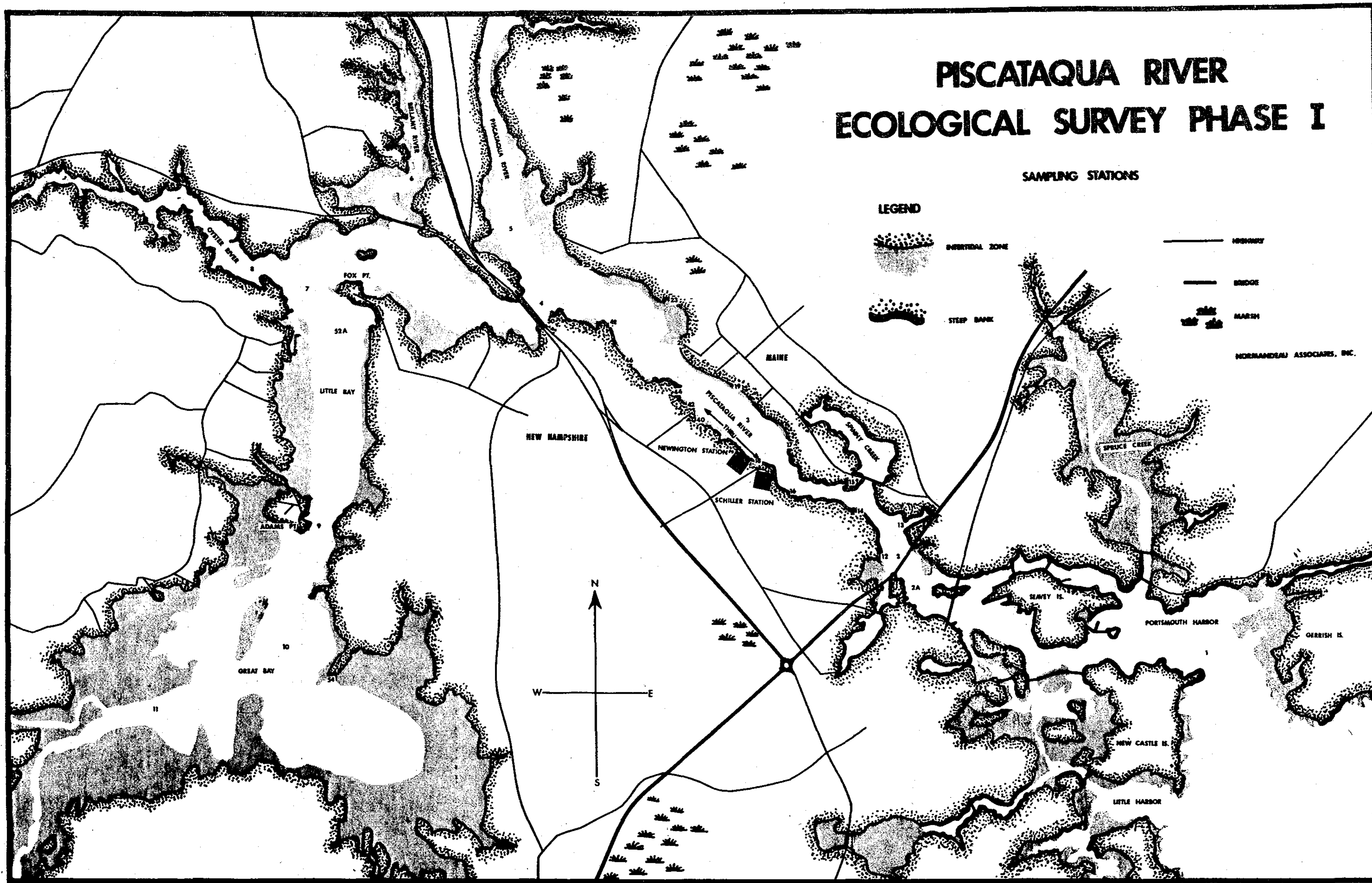
PISCATAQUA RIVER
ECOLOGICAL SURVEY PHASE I
SAMPLING STATIONS
LEGEND
INTERTIDAL ZONE
STEEP BANK
HIGHWAY
BRIDGE
MARSH
NORMANDEAU ASSOCIATES, INC.
OYSTER RIVER
FOX PT.
LITTLE BAY
ADAMS PT.
GREAT BAY
NEW HAMPSHIRE
MAINE
PISCATAQUA RIVER
NEWINGTON STATION
SCHILLER STATION
SPRUCE CREEK
SEAVEY IS.
PORTSMOUTH HARBOR
GERRISH IS.
NEW CASTLE IS.
LITTLE HARBOR
N
S
W
E

FIG. 4

19a

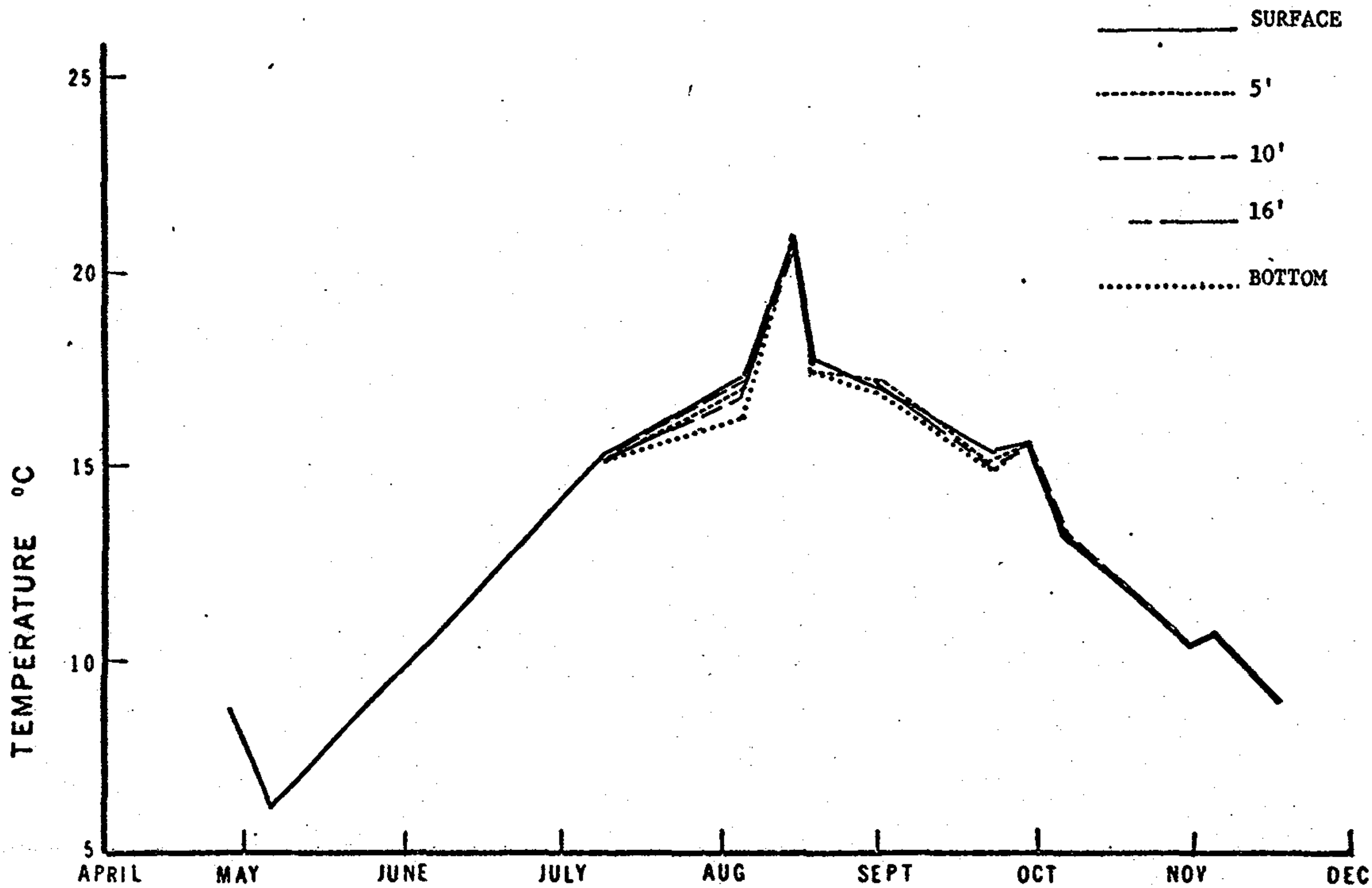

Figure 5. Flood tide temperatures - Piscataqua River Estuary - Station 3.

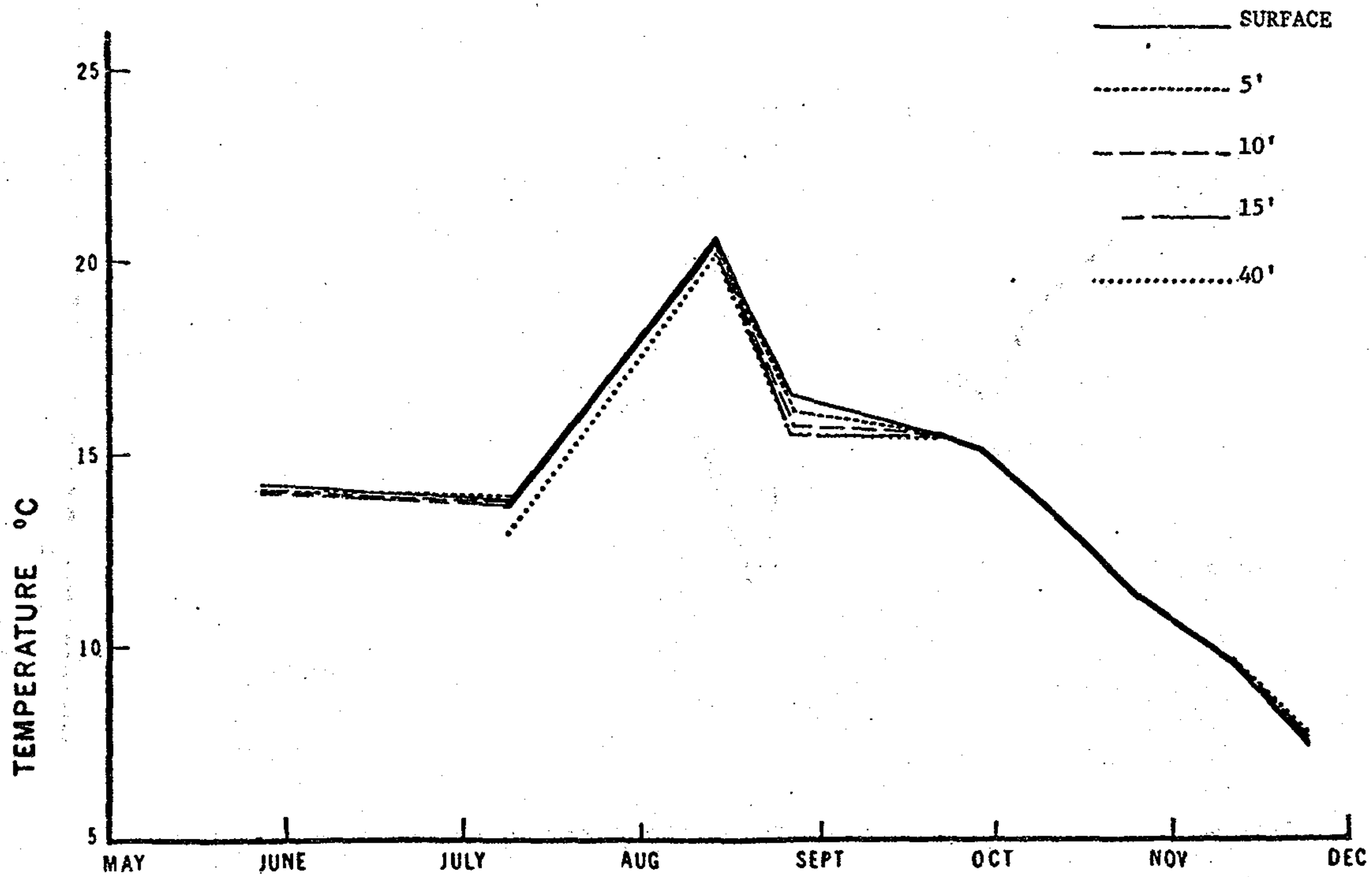

Figure 6. Ebb tide temperatures - Piscataqua River Estuary - Station 3.

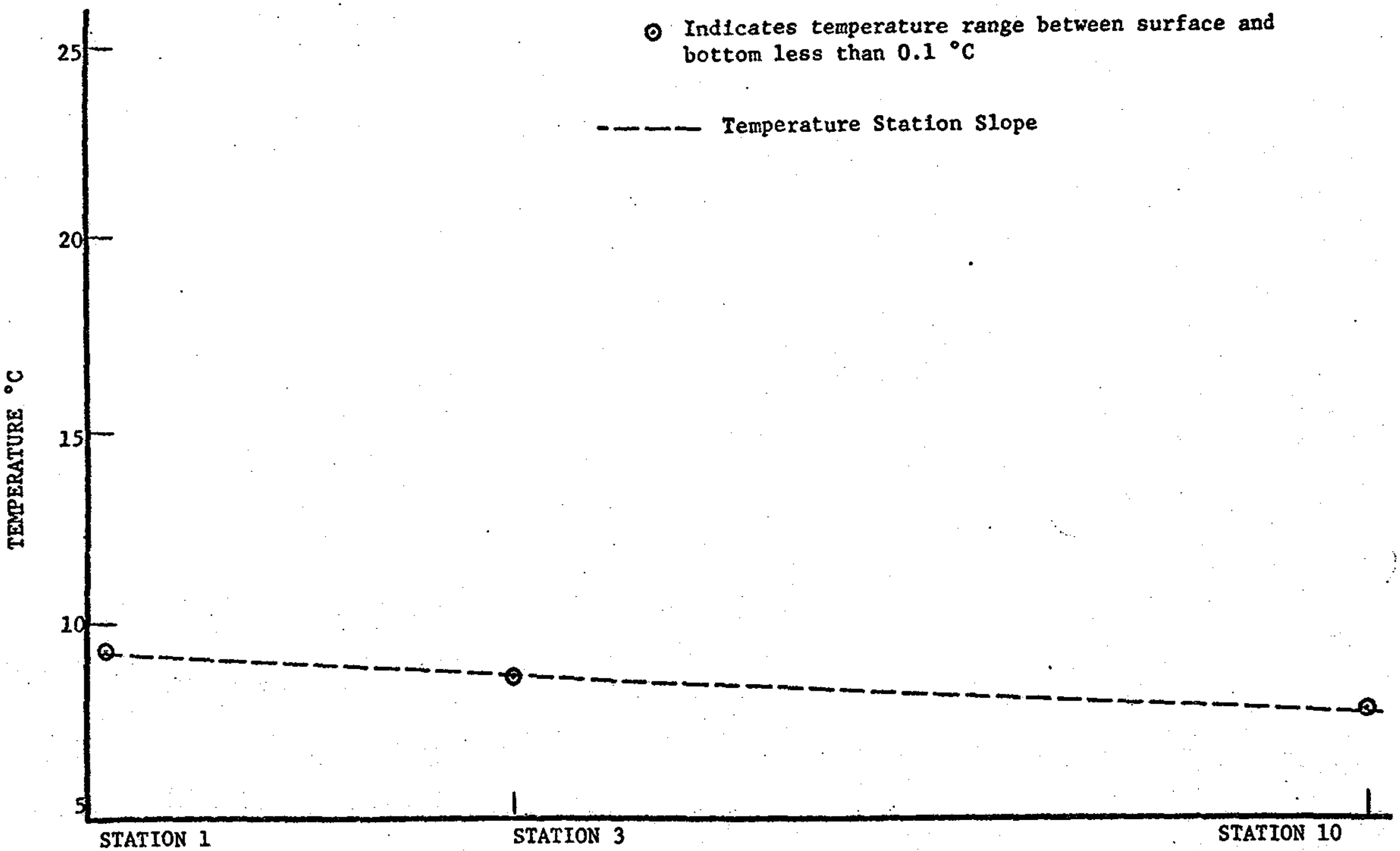

Figure 7. Flood tide temperature ranges - Piscataqua River Estuary - Stations 1, 3, and 10 - November 17, 1970.

Temperature Profiles

Profiles covering the warmest part of the summer from early July to late September 1970, showed that temperatures throughout the estuary were consistently higher than harbor temperatures on both flood and ebb tides. Temperatures steadily increased from Station 1 in Portsmouth Harbor to Station 10 in Great Bay. Figures 8 and 9 indicate temperature variations occuring at different depths with respect to tide for Stations 1, 3 and 9 on specific dates.

In spite of significant temperature differences between harbor and estuarine waters there is little evidence of thermal stratification in the estuary. In summer, the water near the surface is slightly warmer than that near bottom. However, at Station 1, the cold wedge of ocean water at the 50 foot level is considerably cooler than the surface water. This cold wedge loses its identity quickly as it enters the narrow channel and the water is well mixed by the time it enters the main channel in the Newington area. The general temperature difference recorded between surface and bottom (40 feet or greater) in the channel during all sampling periods was only 2.0° C. Exceptions to this general statement were stations near the mouths of rivers, which exhibited slightly greater differences. Even at Station 10 in Great Bay, where the current is considerably slower, surface readings did not vary greatly from bottom readings and most samples at this station showed less than 1.0° C difference.

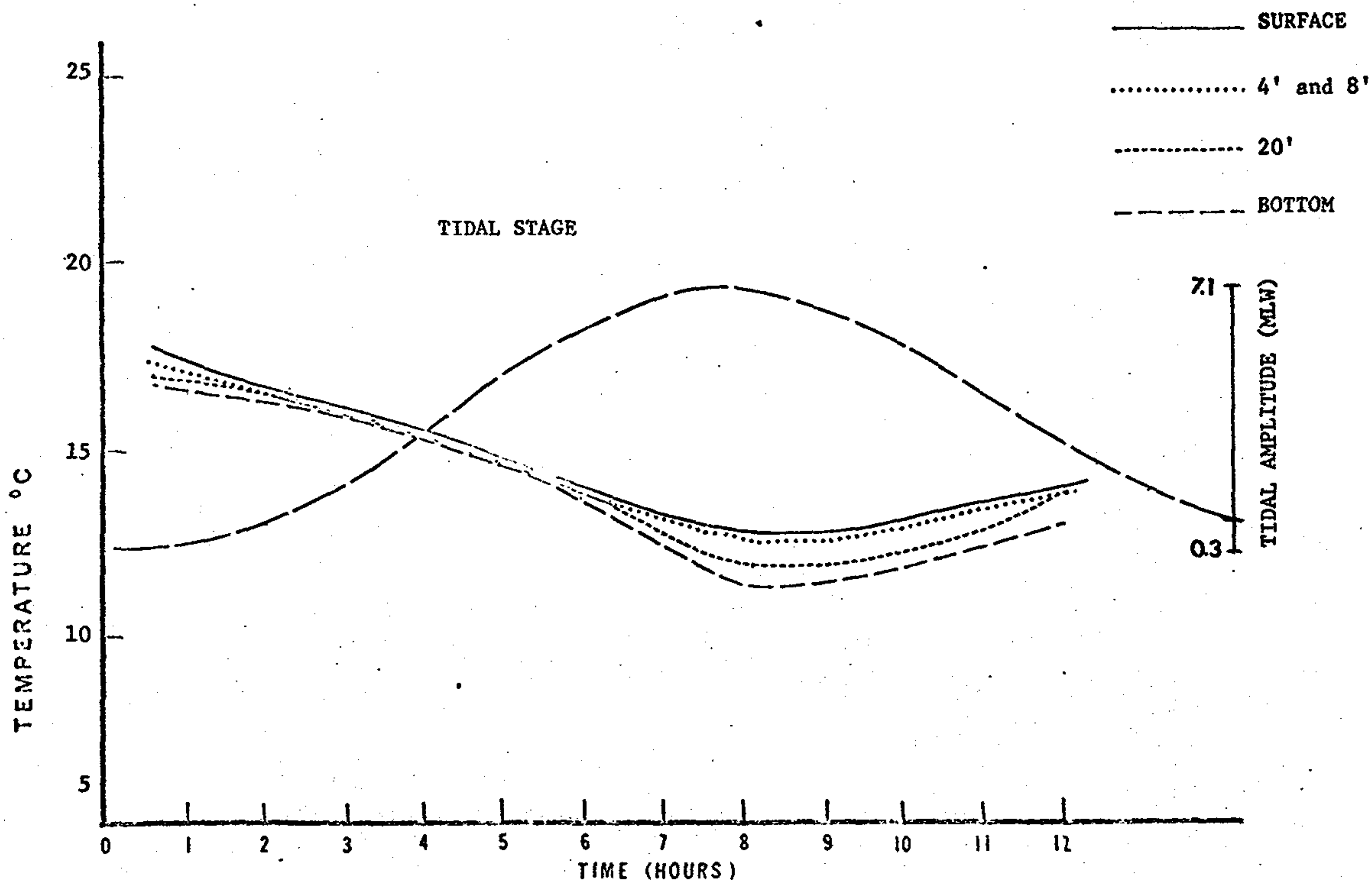

Figure 8. Temperature profile over a tidal cycle - Piscataqua River Estuary - Station 3 - July 9, 1970.

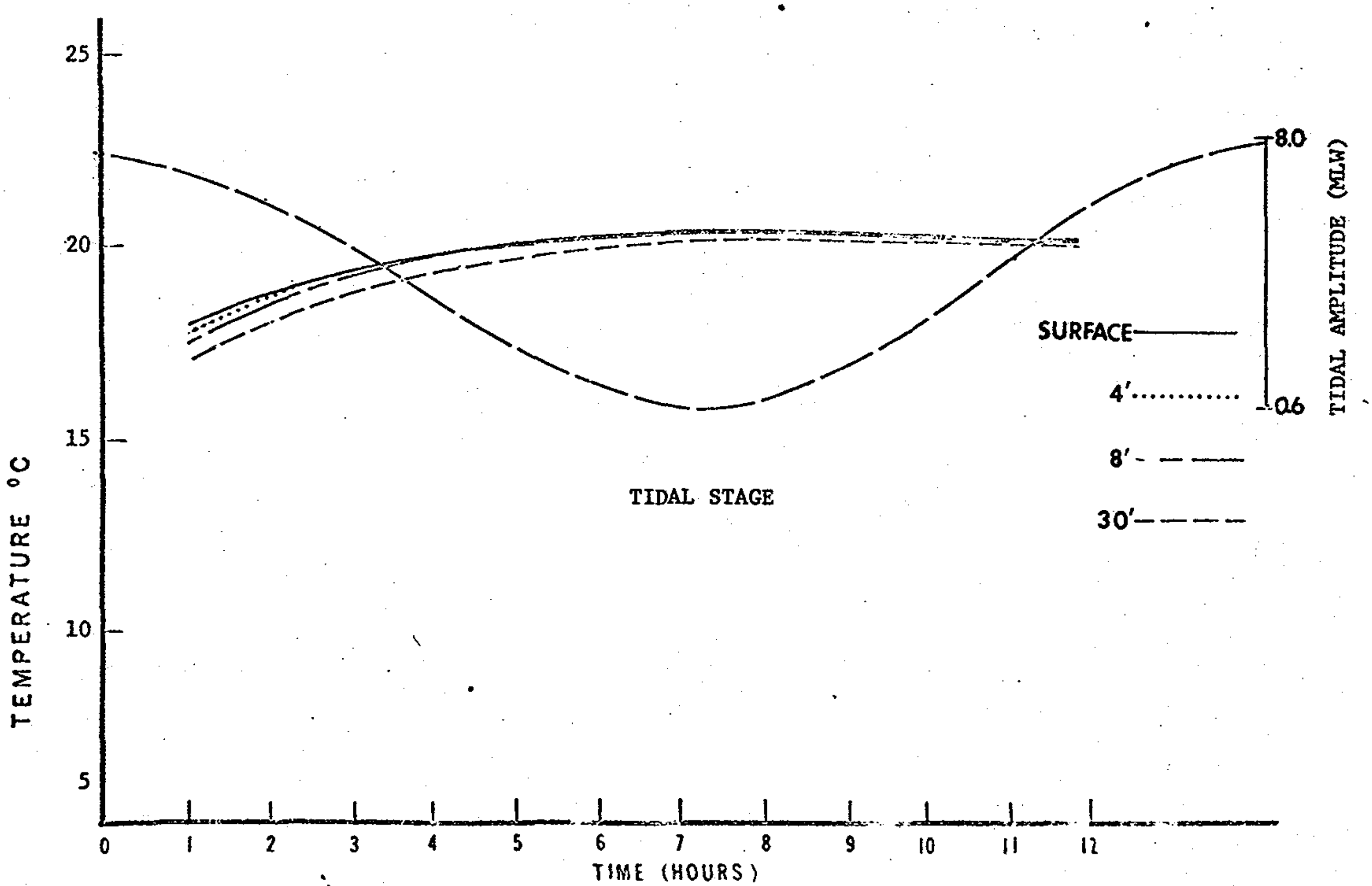

Figure 9. Temperature profile over a tidal cycle - Piscataqua River Estuary - Station 3 - August 14, 1971.

Daily Temperature Fluctuations in the Piscataqua River

More detailed studies, including continuous temperature monitoring, were conducted at stations between the Simplex Pier and the Schiller Generating Station. The maximum summer surface temperature recorded in the Simplex Pier area was 21.7° C on August 16, but temperatures reached 20.0° C on 11 days in August (Fig. 10). On five of these days the minimum surface temperature did not drop below 18° C. The average maximum surface temperature from July 24 to September 19 was 18.3° C. The maximum twenty-four hour fluctuation in surface temperature was 6.7° C, occurring July 27 and August 3 and 4, 1970 (Fig. 10). Further analysis of recorded data for the month of August revealed a time lag between extremes in tidal amplitude and temperature maxima-minima (Fig. 11).

Temperature profiles taken between the Simplex Pier and the Schiller Generating Station indicated that mixing occurs on both ebb and flood tides (Figures 12 and 13). On flood tides the temperature varied less than 3.2° C among all stations, and the greatest deviation from surface to bottom was 1.6° C. On the ebb tide temperatures varied 2.5° C or less among all stations and the greatest deviation from surface to bottom was 0.3° C. Ebb and flood slack tides varied less than 2.0° C among all stations, and the maximum surface to bottom difference was 0.8° C.

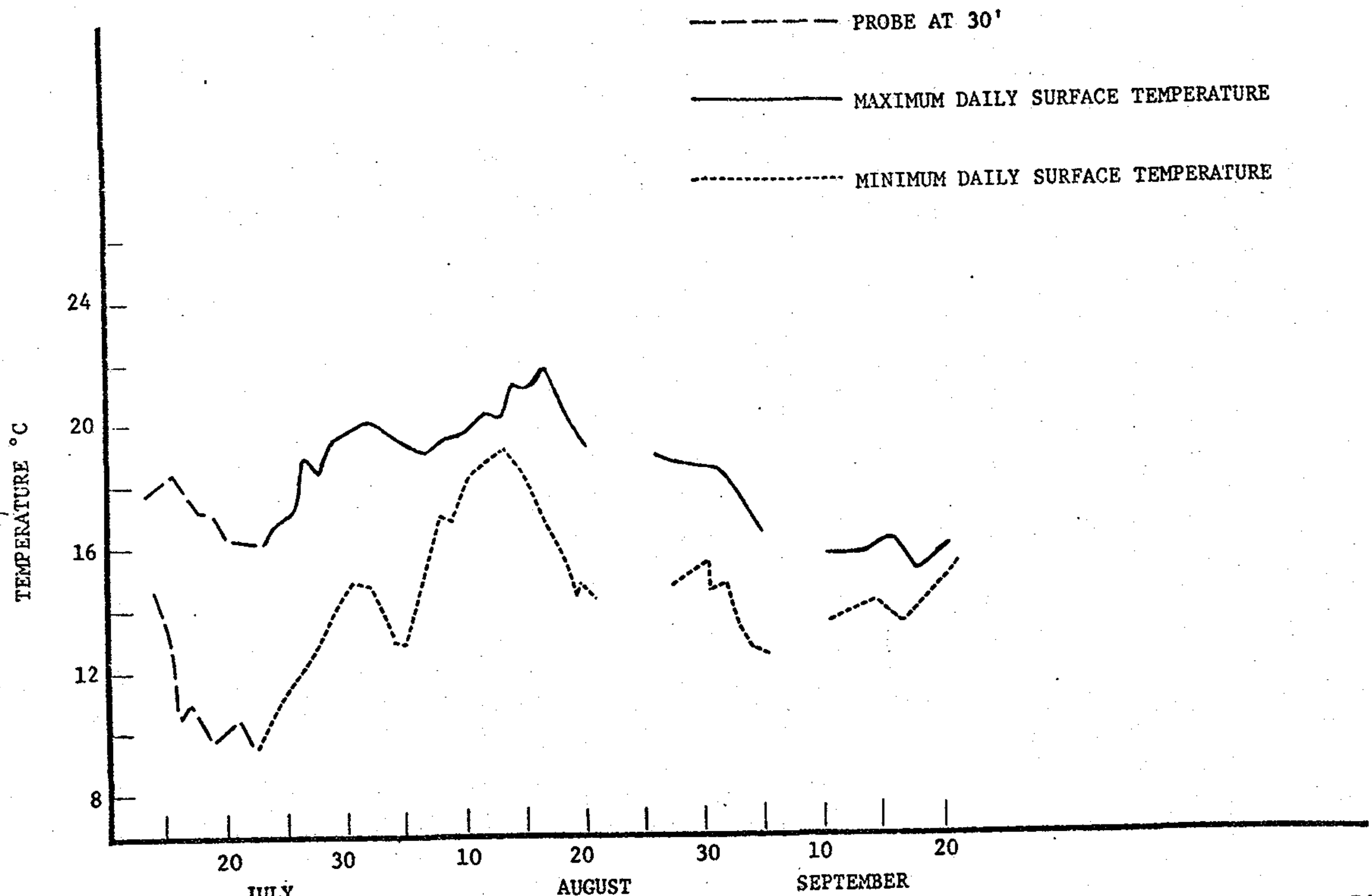

Figure 10. Maximum-minimum daily surface temperatures - Piscataqua River Estuary - Simplex Pier.

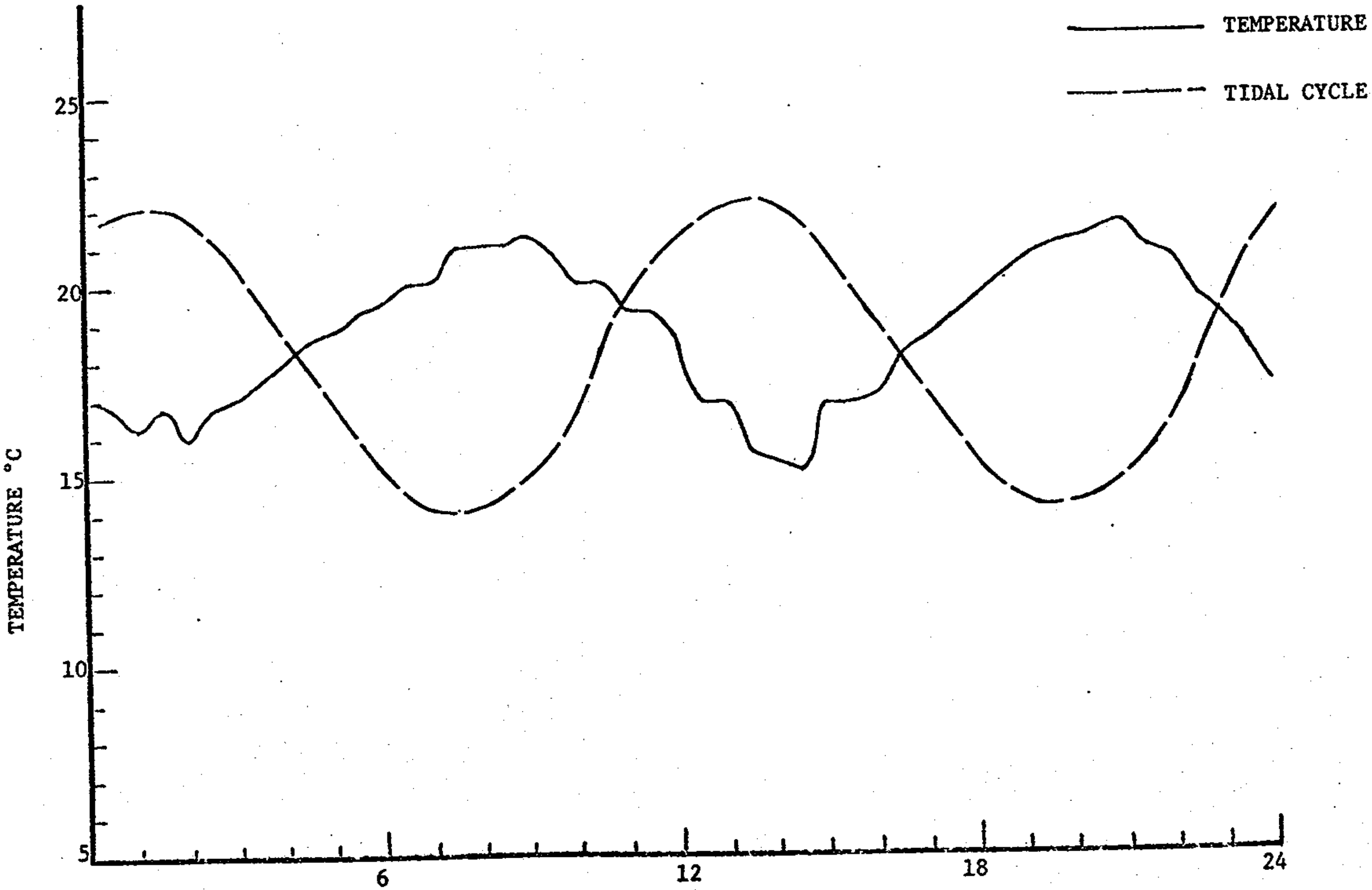

Figure 11. Surface temperature versus tidal cycle - Piscataqua River Estuary - Simplex Pier - August 17, 1970.

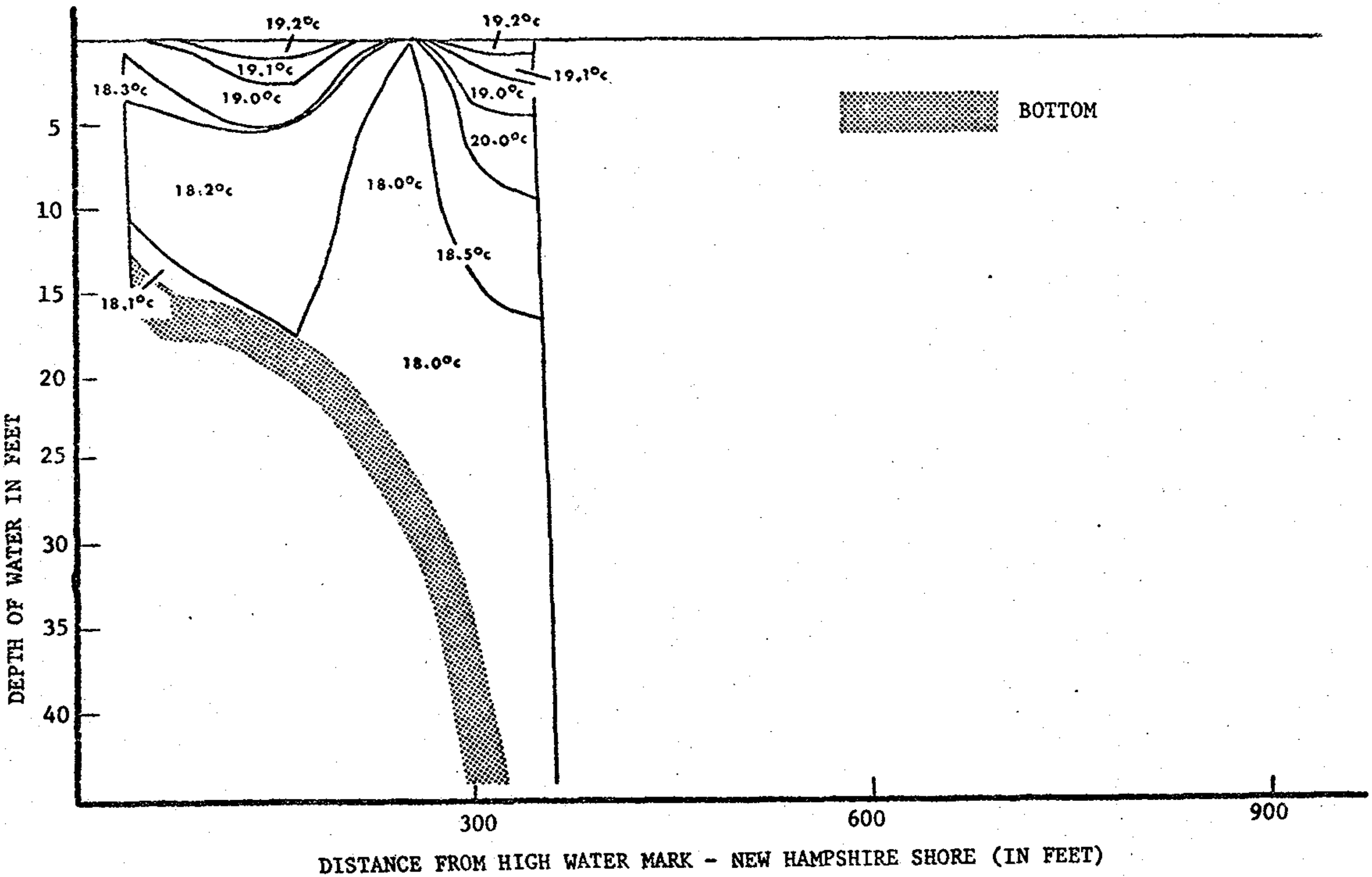

Figure 12. Flood tide temperature profile, July 1970 - Piscataqua River Estuary - Transect 18 + 00.

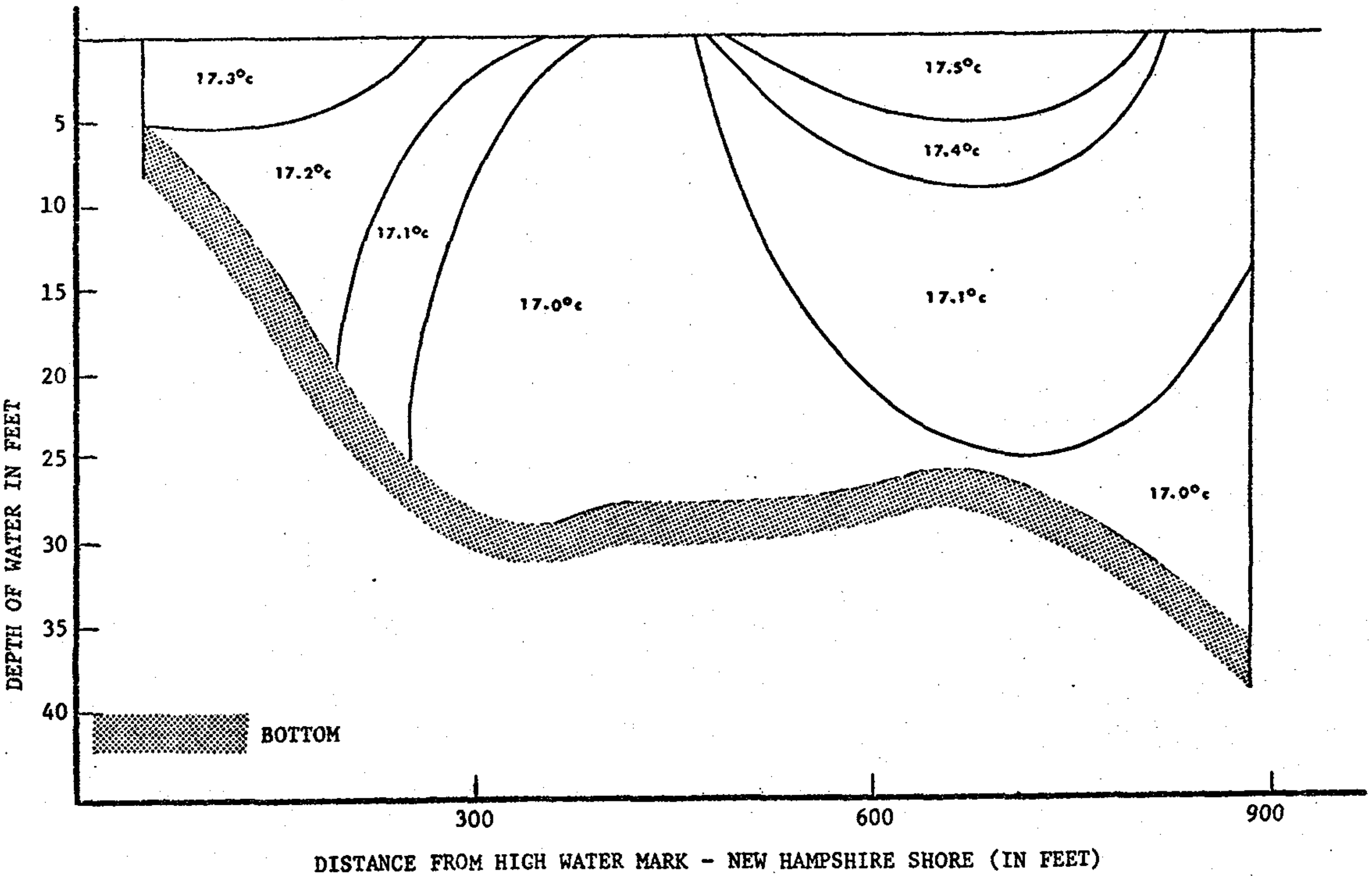

Figure 13. Flood tide temperature profile, July 1970 - Piscataqua River Estuary - Transect 30 + 00.

B. Salinity

Seasonal Salinity Variations

Salinities varied with season, reading generally low in the spring, increasing during the summer and decreasing slightly in the fall (Fig. 14 and 15). Low salinities in the upper estuary in April probably indicated the effects of spring runoff. There was a general increase in salinity values through May. By the beginning of June, salinities on the flood tide were over 20 $^{o}/oo$ in all parts of the estuary (Fig. 14).

As freshwater flows decreased during the summer, salinity increased to above 28.0 $^{o}/oo$ in the upper estuary. There occurred slight variation between the ebb and flood surface reading (Figures 34 and 35). The highest surface reading of the summer (32.5 $^{o}/oo$) was recorded on August 18, 1970 at Station 1. However, the highest overall salinities occurred in September with values exceeding 30.0 $^{o}/oo$ at all stations.

Autumn rains could account for decreased salinities in October and early November. Freezing conditions and the resulting decrease in freshwater runoff possibly contributed to the upward trend in salinity values in December 1970.

Salinity Variations Throughout the Estuary

Salinity values were generally higher at Station 1 than at any station in the estuary. Salinities tended to decrease on all phases of the tide as the distance from the harbor mouth increased. Results of salinity measurements, taken at various stations in the estuary throughout the survey period, are presented in Tables II and III. The measurements generally showed higher salinities with depth, but a well-defined saline wedge was not apparent.

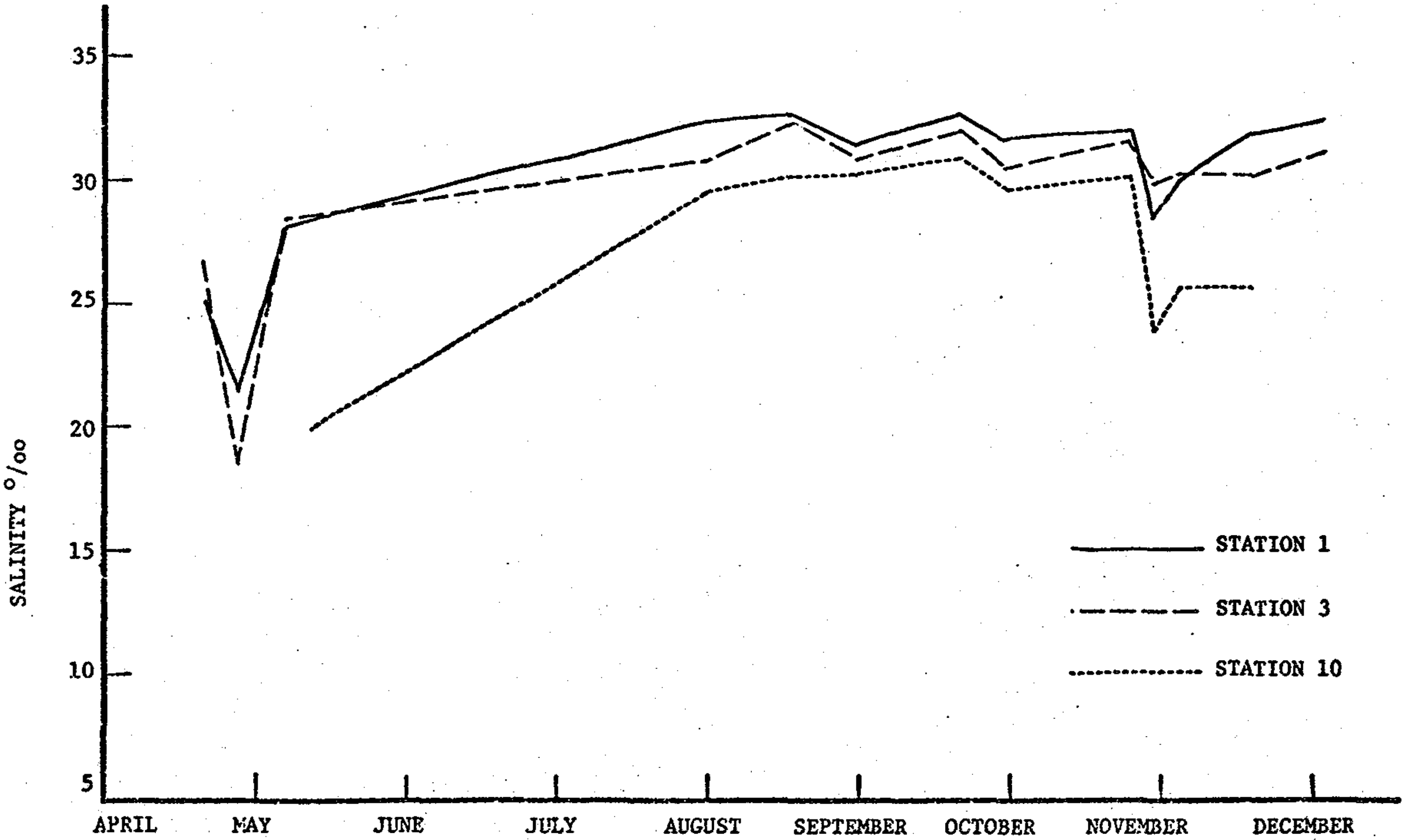

Figure 14. Flood tide surface salinities - Piscataqua River Estuary - Stations 1, 3 and 10.

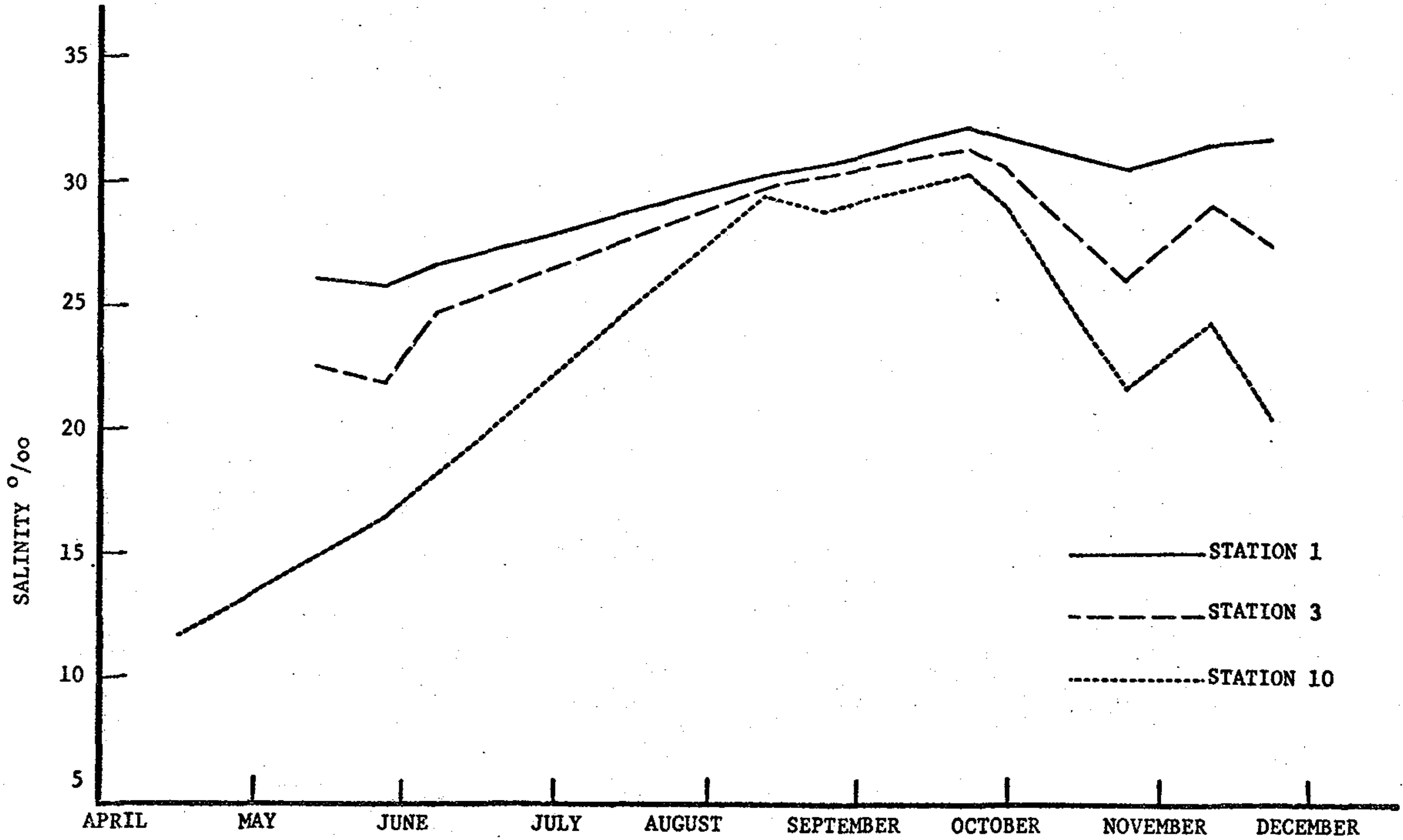

Figure 15. Ebb tide surface salinities - Piscataqua River Estuary - Stations 1, 3 and 10.

TABLE II

SALINITY DATA AT VARIOUS DEPTHS ON THE EBB TIDE

PISCATAQUA RIVER ECOLOGICAL STUDY

SALINITY IN PARTS PER THOUSAND

SAMPLING DATES 1970	STATION	SAMPLING DEPTHS Surface	10'	20'	30'
April 17	7	12.8	12.9	13.8	- - -
	9	11.0	12.3	12.3	- - -
	10	11.8	11.4	12.0	- - -
April 21	7	16.8	20.2	- - -	- - -
May 5	9	19.3	19.6	20.1	- - -
May 12	1	26.2	27.7	27.8	- - -
	3	22.6	22.8	22.9	- - -
	4	21.7	- - -	- - -	- - -
May 27	1	25.8	26.3	26.4	- - -
	3	21.9	22.0	22.0	- - -
	4	19.3	21.2	21.3	- - -
	7	19.4	19.8	20.1	- - -
	9	18.5	18.5	18.6	- - -
	10	16.5	18.7	- - -	- - -
June 8	1	26.7	27.4	27.5	27.4
	3	24.8	25.0	25.3	25.7
	4	22.8	24.3	24.4	24.5
August 14	1	30.4	30.7	30.8	30.6
	3	29.8	29.8	29.9	29.8
	5	26.9	28.3	- - -	- - -
	8	28.9	28.9	- - -	- - -
	10	29.1	28.9	- - -	- - -
August 25	1	30.8	31.3	31.2	31.1
	3	30.3	31.0	30.7	30.9
	6	28.8	- - -	- - -	- - -
	8	29.0	29.1	- - -	- - -
	10	28.9	29.2	- - -	- - -
September 22	1	32.3	32.4	32.4	32.4
	3	31.4	31.6	31.5	31.6
	10	30.2	30.5	30.5	30.7
October 26	1	30.5	30.6	30.7	30.7
	3	26.0	25.9	26.0	26.0
	5	23.8	25.0	- - -	- - -
	10	21.6	24.0	- - -	- - -

(continued)

TABLE II (continued)

Salinity Data at Various Depths on the Ebb Tide - Salinity in Parts Per Thousand

SAMPLING DATES 1970	STATION	SAMPLING DEPTHS Surface	10'	20'	30'
November 11	1	31.5	31.7	31.7	31.8
	3	29.0	29.1	29.1	29.3
	5	20.6	24.8	- - -	- - -
	10	24.3	24.7	25.1	- - -
November 23	1	31.7	31.8	31.9	31.9
	3	27.7	28.1	28.4	28.8
	10	20.6	23.6	- - -	- - -

TABLE III

SALINITY DATA AT VARIOUS DEPTHS ON THE FLOOD TIDE

PISCATAQUA RIVER ECOLOGICAL STUDY

SALINITY IN PARTS PER THOUSAND

SAMPLING DATES 1970	STATION	SAMPLING DEPTHS Surface	10'	20'	30'
April 15	3	16.0	16.2	- - -	- - -
	4	14.1	14.3	- - -	- - -
April 21	1	24.9	- - -	- - -	- - -
	3	26.7	- - -	- - -	- - -
April 27	1	21.3	21.6	22.2	- - -
	2	18.4	- - -	- - -	- - -
	3	18.3	- - -	- - -	- - -
	4	17.3	17.3	17.3	17.3
	7	16.3	- - -	- - -	- - -
	9	16.0	16.2	16.6	16.6
May 5	1	28.0	29.0	29.8	- - -
	3	28.2	- - -	- - -	- - -
	4	27.4	27.4	27.7	- - -
	7	23.0	24.7	24.9	- - -
May 12	7	21.2	21.6	21.6	- - -
	9	21.2	21.6	21.6	- - -
	10	20.2	21.2	21.0	- - -
June 8	7	24.1	24.4	24.3	24.3
	8	22.9	23.7	23.6	23.4
	10	23.1	23.2	23.3	- - -
August 5	1	32.2	31.1	31.7	31.5
	3	30.7	30.7	30.9	31.0
	5	32.2	30.3	30.2	- - -
	6	30.0	- - -	- - -	- - -
	8	29.3	- - -	- - -	- - -
	10	29.4	29.8	29.8	- - -
August 18	1	32.5	32.3	32.1	32.4
	3	32.2	32.2	32.3	32.2
	5	31.4	31.3	31.2	- - -
	6	30.9	- - -	- - -	- - -
	8	31.0	31.1	- - -	- - -
	10	30.0	30.7	30.7	30.7

(continued)

TABLE III (continued)

Salinity Data at Various Depths on the Flood Tide - Salinity in Parts Per Thousand

SAMPLING DATES 1970	STATION	SAMPLING DEPTHS Surface	10'	20'	30'
September 1	1	31.2	31.4	31.5	31.7
	3	30.8	30.6	30.6	30.7
	5	30.5	30.6	- - -	- - -
	6	30.1	- - -	- - -	- - -
	8	30.1	30.2	- - -	- - -
	10	30.0	30.2	- - -	- - -
September 21	1	32.5	32.1	32.4	32.3
	3	31.9	31.9	32.0	32.0
	10	30.8	30.8	- - -	- - -
October 26	1	31.8	32.2	32.3	- - -
	3	31.6	31.4	31.3	- - -
	10	29.9	29.9	29.8	- - -
October 30	1	28.4	29.5	31.7	31.7
	3	29.6	29.6	29.9	29.8
	5	27.6	27.8	- - -	- - -
	10	23.8	23.8	23.7	- - -
November 4	1	29.8	31.1	31.2	31.4
	3	29.9	30.1	30.1	30.3
	5	28.3	28.4	28.4	- - -
	10	25.4	25.5	25.4	- - -
November 17	1	31.7	31.9	32.0	32.2
	3	29.9	30.9	30.9	30.9
	10	25.4	26.0	25.9	- - -
December 2	1	32.3	32.5	32.5	32.7
	3	31.0	31.1	31.0	31.0

C. Dissolved Oxygen

Surface dissolved oxygen values in the Piscataqua River Estuary during the study period ranged from 7.3 to 9.6 ppm. Data taken during twelve hour tidal cycles in July, September, and on the flood tide in November, 1970 are presented in Table IV. These data indicate a uniform distribution of dissolved oxygen throughout the estuary on both the ebb and flood tides. Relatively high dissolved oxygen readings were recorded in the early summer, while lower values were observed in September just after the warmest period of the summer. Dissolved oxygen concentrations increased again as water temperatures dropped.

TABLE IV

DISSOLVED OXYGEN MEASUREMENTS

AT STATIONS 1, 3 and 10 - PISCATAQUA RIVER ESTUARY

DATE (1970)	STATION	TIDE	Dissolved Oxygen (mg/L)	Temperature °C
July 31	1	Flood	8.1	16.0°
	3	Flood	8.2	18.0°
	7	Flood	8.2	21.0°
	10	Flood	7.6	23.0°
September 22	1	Flood	7.7	15.0°
	3	Flood	7.4	15.3°
	10	Flood	7.6	17.5°
November 10	1	Flood	9.5	9.3°
	3	Flood	9.6	8.8°
	10	Flood	9.5	8.0°
July 31	1	Ebb	9.0	14.0°
	3	Ebb	8.1	18.0°
	7	Ebb	7.8	20.0°
	10	Ebb	8.1	23.0°
September 22	1	Ebb	7.6	14.3°
	3	Ebb	7.3	15.6°
	10	Ebb	7.9	18.3°

D. Turbidity

The major cause of turbidity in most estuarine systems is the suspended organic and inorganic particulate matter carried into the area by rivers and streams. In the Piscataqua River estuary another important cause of turbidity in shallow water is sediment stirred up by wind and wave action. Other seasonal sources of turbidity and periodic blooms of plankton which often cloud the water, brown tannic acid and other organic acids released as a result of decomposition of vegetation.

Seasonal Depth of Visibility Fluctuation

The turbidity of most estuarine areas varies considerably throughout the year, usually reaching a maximum during periods of heavy rainfall. In the Piscataqua River estuary, the seasonal variation in D.V. from May until September, 1970, was closely associated with spring freshwater runoff (Table V). In May and June depths of visibility were shallow throughout the estuary, with the exception of Station 1. There was a gradual increase in depths of visibility at all stations during the summer as spring runoff decreased. This increase leveled off in late July and fluctuated with daily conditions thereafter. Readings were generally highest at Station 1 (between 15 feet and 31 feet), and consistently lowest at Station 10 (7 feet to 7.5 feet). During all seasons of the year, turbidity readings increased with distance from the harbor mouth.

TABLE V

DEPTH OF VISIBILITY READINGS - PISCATAQUA RIVER ESTUARY - 1970

Date	Station	Tide	Seccni Disc Depth of Visibility in Feet
May 27, 1970	1	Ebb	14 +
June 8, 1970	1	Ebb	14 +
July 28, 1970	1	Ebb	27.0
July 28, 1970	1	Ebb Slack	20.5
July 31, 1970	1	Ebb	25.0
July 28, 1970	1	Flood	21.0
July 28, 1970	1	Flood Slack	31.0
July 31, 1970	1	Flood	19.0
August 5, 1970	1	Flood	15.0
August 14, 1970	1	Flood Slack	16.0
September 1, 1970	1	Flood	15.0
July 28, 1970	3	Flood	13.5
July 28, 1970	3	Flood	21.0
July 31, 1970	3	Flood	16.0
August 5, 1970	3	Flood	13.0
August 14, 1970	3	Flood Slack	20.5
September 1, 1970	3	Flood	14.0
May 12, 1970	3	Ebb	8.5
May 27, 1970	3	Ebb	7.3
June 8, 1970	3	Ebb	9.0
July 28, 1970	3	Ebb	15.0
July 31, 1970	3	Ebb	19.0
May 12, 1970	7	Flood	6.5
June 8, 1970	7	Flood	8.5
July 28, 1970	7	Flood	9.5
July 28, 1970	7	Flood Slack	11.0
July 31, 1970	7	Flood	9.0
May 27, 1970	7	Ebb	4.8
July 28, 1970	7	Ebb	8.5
July 28, 1970	7	Ebb Slack	6.0
July 31, 1970	7	Ebb	10.0
May 12, 1970	9	Flood	6.0
June 8, 1970	9	Flood	7.5
June 8, 1970	10	Flood	7.5
July 28, 1970	9	Flood	7.0
July 28, 1970	9	Flood Slack	7.5
July 31, 1970	10	Flood	7.0
August 5, 1970	10	Flood	7.0
September 1, 1970	10	Flood	7.0

Effect of Tide on Depth of Visibility

Depths of visibility were measured at selected stations in the main channel throughout an entire tidal cycle on July 28, 1970 (Figure 36). A progressive decrease in D.V. occurred from Station 1, at the ocean, to Station 9, in the upper estuary. This decrease was evident at all stages of the tidal cycle. Depth of visibility readings varied according to the tidal cycle, with lowest readings occurring during the ebb slack tide and highest during flood slack tide.

Greatest differences in depths of visibility between flood slack and ebb slack tides were recorded at the Harbor Stations 1 and 2, and least differences were observed at Station 9 in Great Bay where the D. V. was consistently shallow.

E. Finfish

The Piscataqua River Estuary was well known for its variety and abundance of finfish in colonial times. Even though pollution and destruction of breeding grounds have greatly reduced their numbers, fishes are still one of the most important groups of marine organisms in the Piscataqua River Estuary. Intensive sport and recreational fishing occurs seasonally for alewives, mackerel, striped bass, pollock, flounder, and a newly introduced species, the coho salmon. Smelt are caught in the bays during the winter by sport fishermen and commercially around the mouth of the Lamprey River.

Twenty-seven species of fish were captured throughout the 1970 finfish sampling period (Table VI). Twenty-one were found in the area between the Simplex Pier and the Schiller Plant.

During the first collecting period (Phase I), most species were

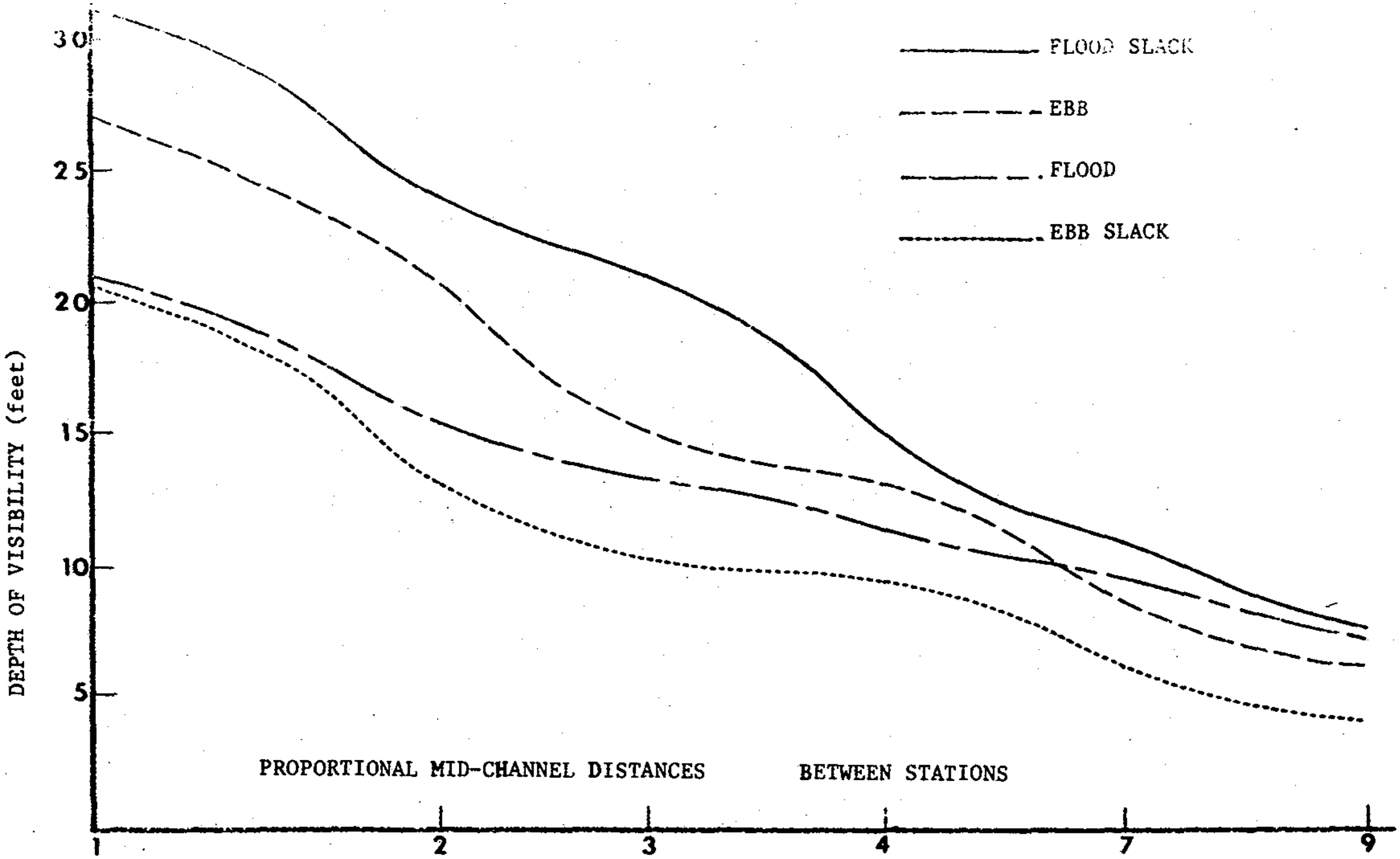

Figure 16. Turbidity over a tidal cycle - Piscataqua River Estuary - Stations 1, 2, 3, 4, 7 and 9 - July 28, 1970.

captured by seining on both the Maine and New Hampshire sides of the Piscataqua River. Minor effort was expended on various other methods such as dip netting and rod and reel. Twenty species of finfish were captured in this sampling period (Table VI). Sixteen species were found in the Schiller-Simplex area.

Nineteen species of fish were caught during the second collecting period (Phase II). Fifteen species were taken in the Schiller-Simplex area. Species composition was similar to that of the first collection, but three species (striped bass, Morone saxatilis; mackerel, Scomber scombrus; and northern puffer, Sphoeroides maculatus) were added to the total list for the area. Four species previously captured were not found on this effort (Atlantic cod, Gadus morhua; hake, Urophycis sp.; tautog, Tautoga onitis; and alewife, Alosa pseudoharengus).

Species abundance varied among stations and differed considerably from the first collection period. There was a significant increase in the abundance of Atlantic silverside, Menidia menidia; rainbow smelt, Osmerus mordax; and smooth flounder, Liopsetta putnami. In some cases, as with the rainbow smelt, captured fish were schooling juveniles from the spring hatching. Sticklebacks, Pungitius pungitius and Apeltes quadracus; and Atlantic tomcod, Microgadus tomcod; showed a considerable decline in abundance from the previous sampling period.

The third collecting period (Phase III) involved seining, trawling, gill netting, SCUBA, and minor rod and reel effort. These combined techniques resulted in the capture of 21 species of fish (Table VI). Sixteen species were collected in the Schiller-Simplex area. Species composition was similar to that of the first two sampling periods with four new species (goosefish, Lophius americanus; skate, Raja sp.; coho salmon, Oncorhynchus kisutch; and brown trout, Salmo trutta) added to the total list for the area. Species abundance was generally lower than in previous collections except for large schools of silversides and juvenile rainbow smelt.

Finfish studies were primarily qualitative, but some measure of relative abundance was achieved by computing catch per unit effort for those species captured by seining. Species and phase C/E indices were computed $\log\{\sum_{i=0}^{n} C_i / \sum_i E_i\}$, where i = individual samples.

Seasonal averages, $\log\{\sum_{i=0}^{n} \sum_{j=1}^{3\ \text{phases}} C_{ij} / \sum_{ij}\sum E_{ij}\}$,

In general, species composition and relative population densities were comparable at most stations throughout the study area. Fundulus heteroclitus, Menidia menidia, and Osmerus mordax were the most abundant species collected in the Piscataqua River. Pseudopleuronectes americanus, Liopsetta putnami, Myoxocephalus aenaeus, Pungitius pungitius, Apeltes quadracus and Gasterosteus aculeatus were also present in large numbers. Osmerus mordax, Myoxocephalus aenaeus, and Urophycis sp. were more abundant and Fundulus heteroclitus was less abundant in the Schiller-Simplex area than in the remainder of the study area.

Seasonal fluctuations in abundance of species living in the estuary were evident. Liopsetta putnami, Myoxocephalus aenaeus, and Osmerus mordax were present in greater abundance in mid-summer than in late spring and early fall. Pungitius pungitius, Apeltes quadracus, Gasterosteus aculeatus, Fundulus heteroclitus and Microgadus tomcod decreased

TABLE VI

FINFISH COLLECTIONS - 1970

SPECIES Scientific Name*	Common Name*	1st Collection Phase I May 19 - July 1 TOTAL AREA	 SCHILLER-SIMPLEX	2nd Collection Phase II July 21 - Aug.11 TOTAL AREA	 SCHILLER-SIMPLEX	3rd Collection Phase III Aug. 24 - Nov. 1 TOTAL AREA	 SCHILLER-SIMPLEX
Raja sp.	Skate					X	
Anguilla rostrata	American eel	X	X	X	X	X	
Alosa pseudoharengus	Alewife	X	X				
Oncorhynchus kisutch	Coho salmon					X	X
Salmo trutta	Brown trout					X	X
Osmerus mordax	Rainbow smelt	X	X	X	X	X	X
Lophius americanus	Goosefish					X	
Gadus morhua	Atlantic cod	X	X				
Microgadus tomcod	Atlantic tomcod	X	X	X	X	X	X
Pollachius virens	Pollock	X	X	X	X	X	X
Urophycis sp.	Hake	X	X				
Fundulus heteroclitus	Mummichog	X	X	X	X	X	X
Menidia menidia	Atlantic silverside	X		X	X	X	X
Apeltes quadracus	Fourspine stickleback	X	X	X	X	X	X
Gasterosteus aculeatus	Threespine stickleback	X	X	X	X	X	X
Pungitius pungitius	Ninespine stickleback	X	X	X	X	X	X
Syngnathus fuscus	Northern pipefish	X		X		X	
Morone saxatilis	Striped bass			X	X	X	X
Tautoga onitis	Tautog	X					
Tautogolabrus adspersus	Cunner	X	X	X		X	X
Pholis gunnellus	Rock gunnel	X	X	X	X		
Scomber scombrus	Atlantic mackerel			X	X	X	X
Myoxocephalus aenaeus	Grubby	X	X	X	X	X	X
Cyclopterus lumpus	Lumpfish	X		X		X	
Liopsetta putnami	Smooth Flounder	X	X	X	X	X	X
Pseudopleuronectes americanus	Winter Flounder	X	X	X	X	X	X
Sphoeroides maculatus	Northern puffer			X			

*Scientific and common names of species are taken from the American Fisheries Society, Special Publication No. 6, "A List of Common and Scientific Names of Fishes from the United States and Canada", Third Edition, 1970.

in abundance during the warmer summer months. Menidia menidia increased in abundance from spring through fall, and large schools were found into December. Urophycis sp. was fairly common throughout the study area during the spring, but was not found thereafter. Pseudopleuronectes americanus showed little evidence of fluctuations in abundance.

In the Schiller-Simplex area, Fundulus heteroclitus, Osmerus mordax Liopsetta putnami, and Myoxocephalus aenaeus were more abundant in summer than in spring and fall, whereas Microgadus tomcod, Pungitius pungitius, and Gasterosteus aculeatus decreased in abundance from spring to summer. Menidia menidia and Apeltes quadracus increased in number throughout the study period.

F. Plankton

Results of Seasonal Distribution Surveys

The present study, analyzing plankton samples taken from May through October, 1970, is an initial survey to ascertain species composition and relative abundances. Further proposed studies will lengthen the seasonal sampling time, provide additional twenty-four hour data, and will adhere to a regular schedule of sampling.

Over the total sampling period, the organisms which were most persistent and abundant were: Eurytemora herdmani, Temora longicornis, Centropages hamatus (copepods); Balanus spp. - cyprid and nauplier stages (barnacles); gastropod veligers; and Peridinium depressum, Ceratium longipes (dinoflagellates). Phytoplankton species accounted for the highest total numbers in these samples. Other species which could be termed dominants due to their high numbers were: Acartia

TABLE VII

PLANKTONIC ORGANISMS: CHECKLIST AND PERIODS OF OCCURRENCE

IN THE PISCATAQUA RIVER - 1970 STUDY

SPECIES	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER
Copepoda						
Centropages hamatus	X	Xs	X	Xs	X	X
Centropages typicus	-	-	-	-	X	-
Acartia clausi	-	Xs	Xs	Xs	-	Xs
Acartia longiremus	X	X	X	-	O	O
Acartia tonsa	-	Xs	X	-	X	-
Pseudocalanus minutus	-	Xs	X	Xs	X	O
Eurytemora herdmani	X	Os	O	Os	X	O
Eurytemora hirundoides	-	X	-	X	-	X
Temora longicornis	X	X	X	X	X	X
Pseudodiaptomus coronatus	-	X	X	-	X	X
Calanus finmarchicus	-	X*	X*	-	-	X
Calanus hyperboreus	-	X*	-	-	-	-
Tortanus discaudatus	-	Xs	X	X	-	Xs
Tortanus sp.	-	X	-	-	-	-
Oithona similis	-	X	X	X	O	O
Microsetella norwegica	X	O	X	X	O	X
Saphirella sp.	-	X	-	-	X	-
Harpacticoids	X	X	-	X	X	X
Cladocera						
Podon leuckarti	X	X	X	-	X	X
Podon intermedius	X	X	-	-	-	O
Podon polyphemoides	-	X	X	X	X	X
Evadne nordmanni	-	X	O	X	X	-
Evadne spinifera	-	O	-	X	X	-

(continued)

TABLE VII (continued)

SPECIES	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER
Isopoda						
Jaera marina	-	X*	X*	-	-	X*
Amphipoda						
Corophium volutator	-	-	X	X	-	-
Caprella sp.	-	-	X	-	X	X
Cumacea						
Oxyurostylis smithi	-	-	-	X*	-	-
Euphausidacea						
Thysanoessa inermis	-	X*	-	-	-	-
Mysidacea						
Neomysis americana	-	-	X	-	-	-
Tunicata						
Oikopleura dioica	-	X	-	-	-	-
Hydromedusae	-	X	X	X	X	X
Chaetognatha						
Sagitta elegans	-	X*	-	-	-	X
Crustacean larvae						
Balanus nauplii	X	X	X	X	-	-
Balanus cyprids	X	X	X	X	X	X
Decapod zoea	X	X	X	-	-	-
Decapod megalops	X	X	X	X	X	-

(continued)

TABLE VII (continued)

SPECIES	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER
Molluscan larvae						
Gastropod veligers	–	X	X	X	X	X
Gastropod juveniles	–	X	–	–	–	–
Nudibranch veligers	–	X	X	X	X	–
Mytilus edulis veligers	–	X	X	X	X	X
Modiolus spp. veligers	–	X	X	X	X	X
Anomia aculeata veligers	–	–	X	X	X	X
Mya arenaria veligers	–	X	X	X	X	–
Crassostrea virginica veligers	–	–	X	–	X	–
Other bivalve veligers	X	X	X	X	X	X
Bivalve juveniles	–	–	X	–	–	–
Polychaeta						
Trochophores and larvae	–	X	X	–	X	X
Autolytus sp.	–	–	X	–	–	–
Echinoderm larvae	–	X	X	–	–	–
Fish Eggs	–	X	X	–	X	–
Fish larvae						
Osmerus mordax	–	X	–	–	–	–
Foraminifera	X	X	X	X	X	X
Rotifera	–	–	–	–	–	X
Nematoda	–	X	X	X	–	X
Insect larvae	–	X	–	–	–	–
Tintinnids	–	–	X	X	X	X

(continued)

TABLE VII (continued)

SPECIES	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER
Phytoplankton						
Diatoms						
Melosira moniliformis	–	X	–	–	–	X
Isthmia nervosa	–	X	X	X	X	X
Coscinodiscus sp.	–	X	X	X	X	X
Fragilaria islandica	–	X	X	–	–	–
Fragilaria arctica	–	X	–	–	–	–
Gyrosigma wansbeckii	–	–	X	X	X	X
Gyrosigma balthicum	–	–	–	X	–	–
Chaetoceros sp.	–	–	X	–	–	X
Biddulphia sp.	–	–	–	–	–	X
Dinoflagellates						
Peridinium depressum	X	X	X	X	X	X
Peridinium sp.	–	–	–	X	X	X
Dinophysis acuta	–	–	–	X	X	X
Ceratium lineatum	–	X	–	–	X	X
Ceratium bucephalum	–	–	–	X	X	X
Ceratium fusus	–	–	–	X	X	X
Ceratium longipes	–	X	X	X	X	X

NOTE: X = presence of species; O = gravid (egg bearing); s = spermatophore (sperm sac) attached to ♀; * = immature

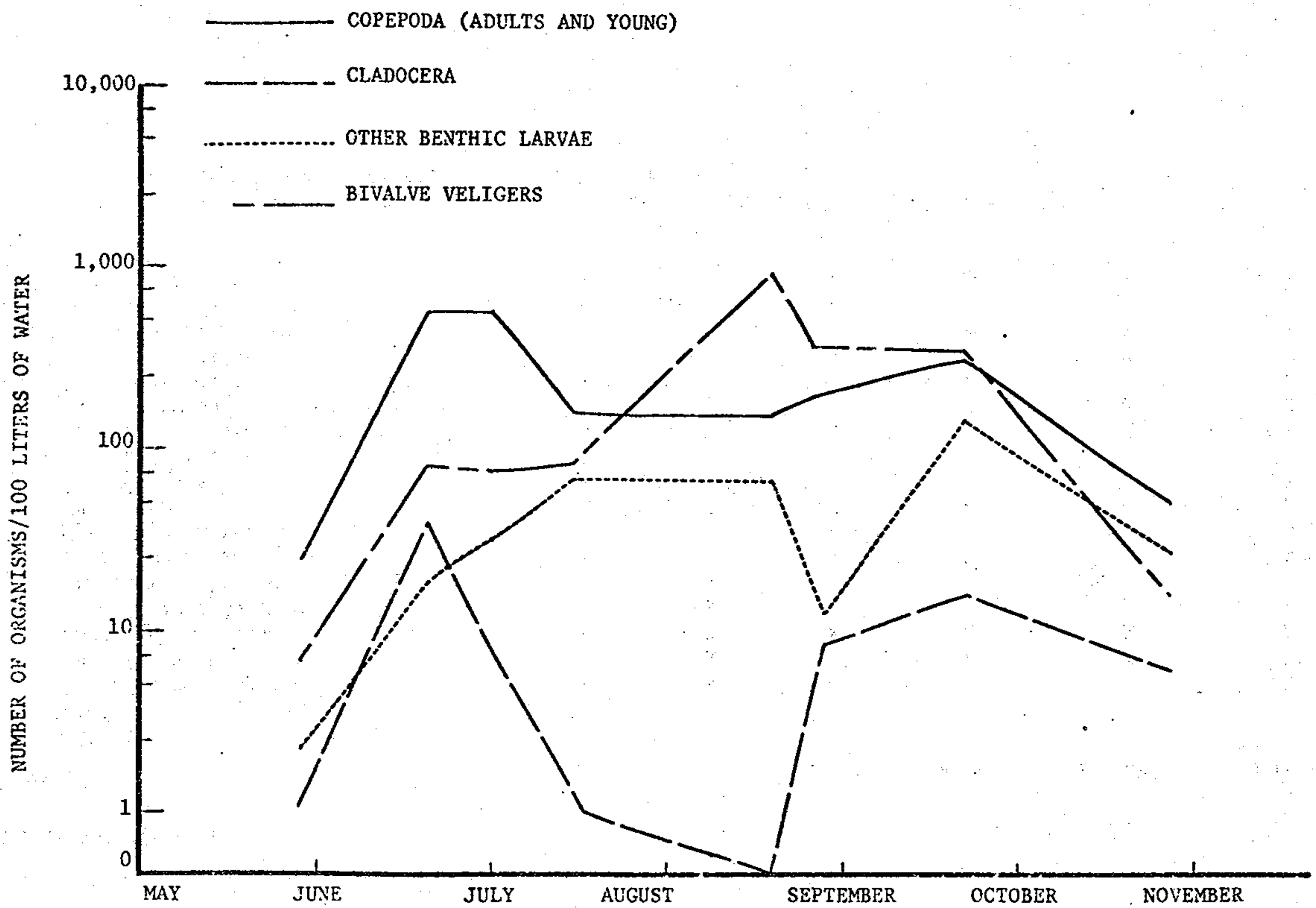

Figure 17. Seasonal distribution of zooplankton in the Piscataqua River Estuary system - Summer 1970.

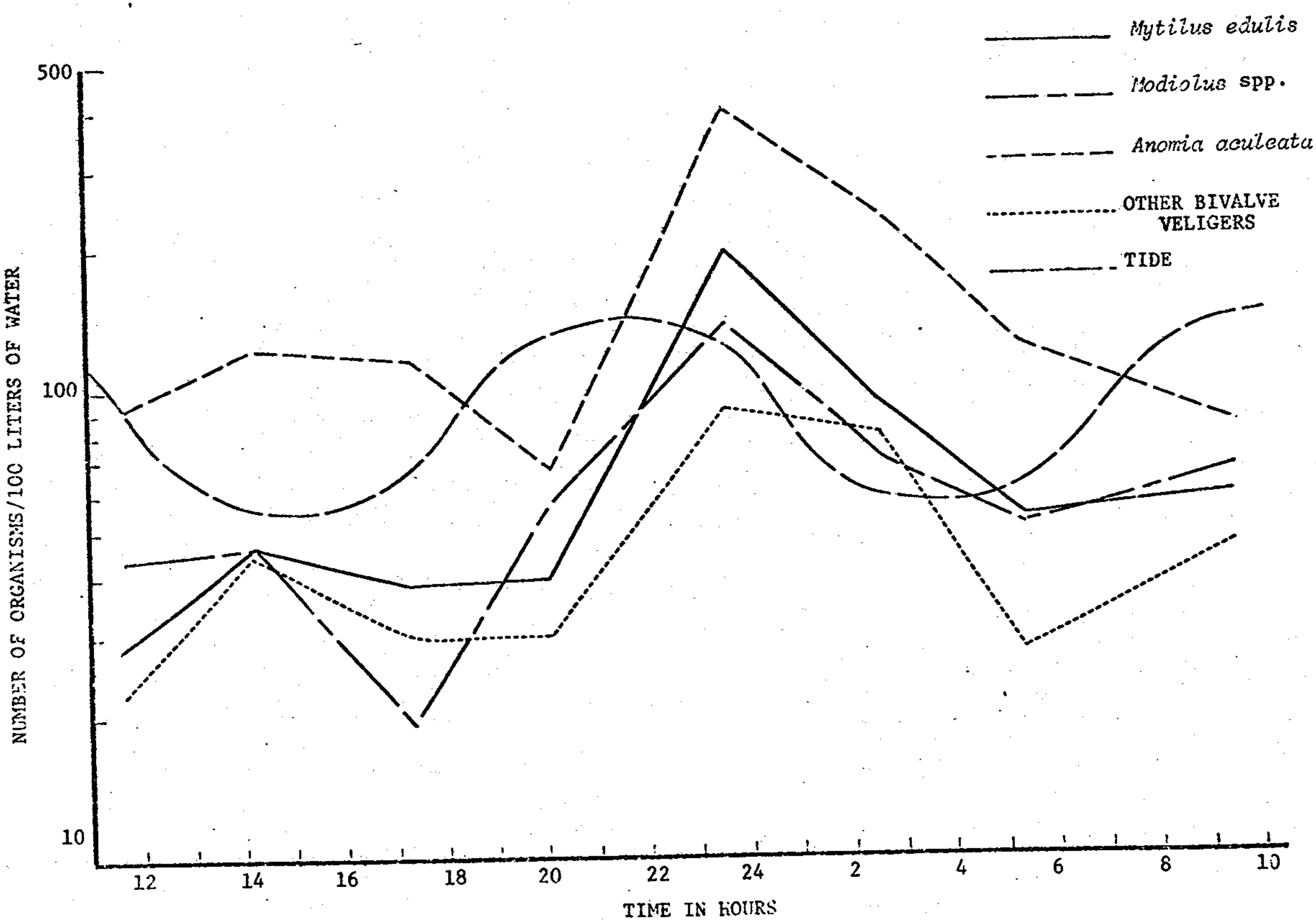

Figure 18. Distribution of bivalve larvae with tidal cycle, 30-31 July 1970, surface samples.

clausi, Oithona similis (copepods); Podon leuckarti (a cladoceran) Isthmia nervosa (a diatom); and Ceratium fusus (a dinoflagellate).

Species composition is quite varied (Table VII) with 53 species representing 38 genera collected. Seventeen species of copepods, five species of cladocera and six species of varied crustacea were identified in the samples. Certain benthic larvae were not identified due to the difficulty of positive identification. Additional bivalves were present in the samples, but were not noted in the graphs since the similarity of these species makes definite identification impossible at this time.

Although samples for Station 3 were only analyzed from June through November, 1970, Figure 17 indicates that most species increased in abundance during the summer months to an early September high, then appeared to decrease in November.

Vertical Distribution of the Plankton

According to results of a 24 hour plankton study conducted near the Schiller Power Plant, concentrations varied with the tide (Figure 12). Total bivalve concentration and that of selected individual species (Mytilus edulis., Modiolus spp., and Anomia aculeata) exhibited greatest abundance at approximately maximum current of flood tide. In contrast, lower values consistently occurred for all species at ebb tide. A higher percentage of bivalve larvae was found in the surface samples than in the ones at depth (20 ft.). Other remaining plankton species were not analyzed at this time.

A comparison of species composition between bottom and surface samples from an ebb tide, June 19, 1970 (Fig. 19) does not suggest a difference between the two depths. Surface and bottom comparisons of bivalve species from a flood tide on October 30, 1970 did not appear to be significantly different (Fig. 20).

Graphs of total bivalves and copepods for surface and bottom samples are very similar. The numbers of cladocera from surface and bottom samples are similar in slope, but the bottom values are approximately ten times greater (Fig. 21). Likewise, the benthic invertebrate larvae were consistently more abundant in the bottom samples than in the surface samples.

Horizontal Distribution of Plankton

Results show a general decrease in concentrations of bivalve larvae (both total and individual species numbers - from Portsmouth to Great Bay). This phenomenon may be associated with several environmental factors, the major one probably being salinity. Concentrations of larvae for individual species varied with time of year and were probably associated with the spawning habits of the individual species. There were no *Anomia aculeata* or *Crassostrea virginica* in the June 19, 1970 samples and no *Mya arenaria* or *Crassostrea virginica* in the October 30, 1970 samples. In addition, for the latter date, the remaining bivalve species decreased to a zero at Station 10 (Great Bay) and *Anomia aculeata* disappeared from the bottom samples at Station 3 (Schiller Station).

The horizontal distribution of copepods and benthic invertebrate larvae appears to be rather erratic (Fig. 21). Yet when the distributions of separate adult species are plotted, it is shown that the

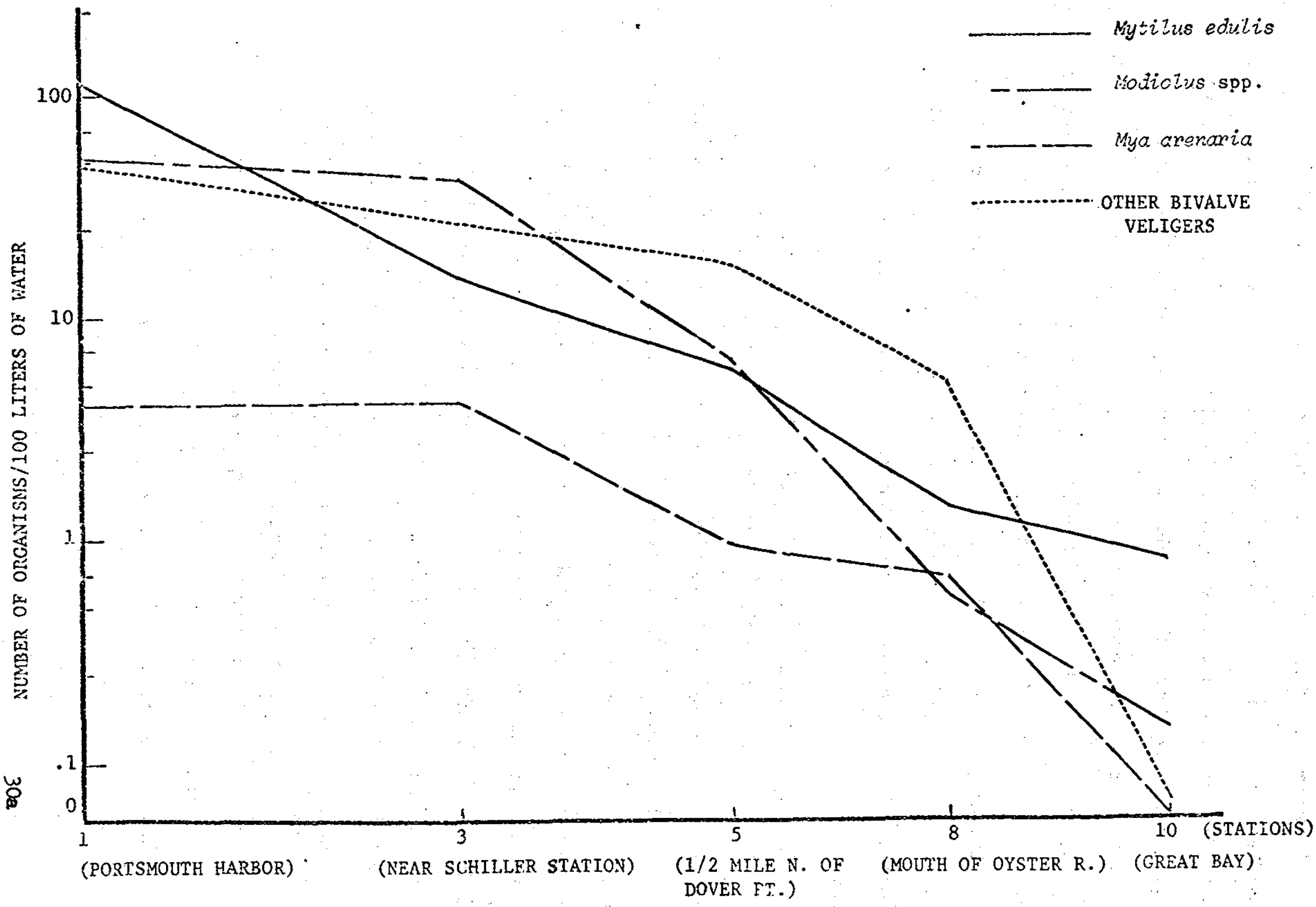

Figure 19. Horizontal distribution of bivalve larvae within the Piscataqua River Estuary system, 19 June 1970, surface samples on ebb tide.

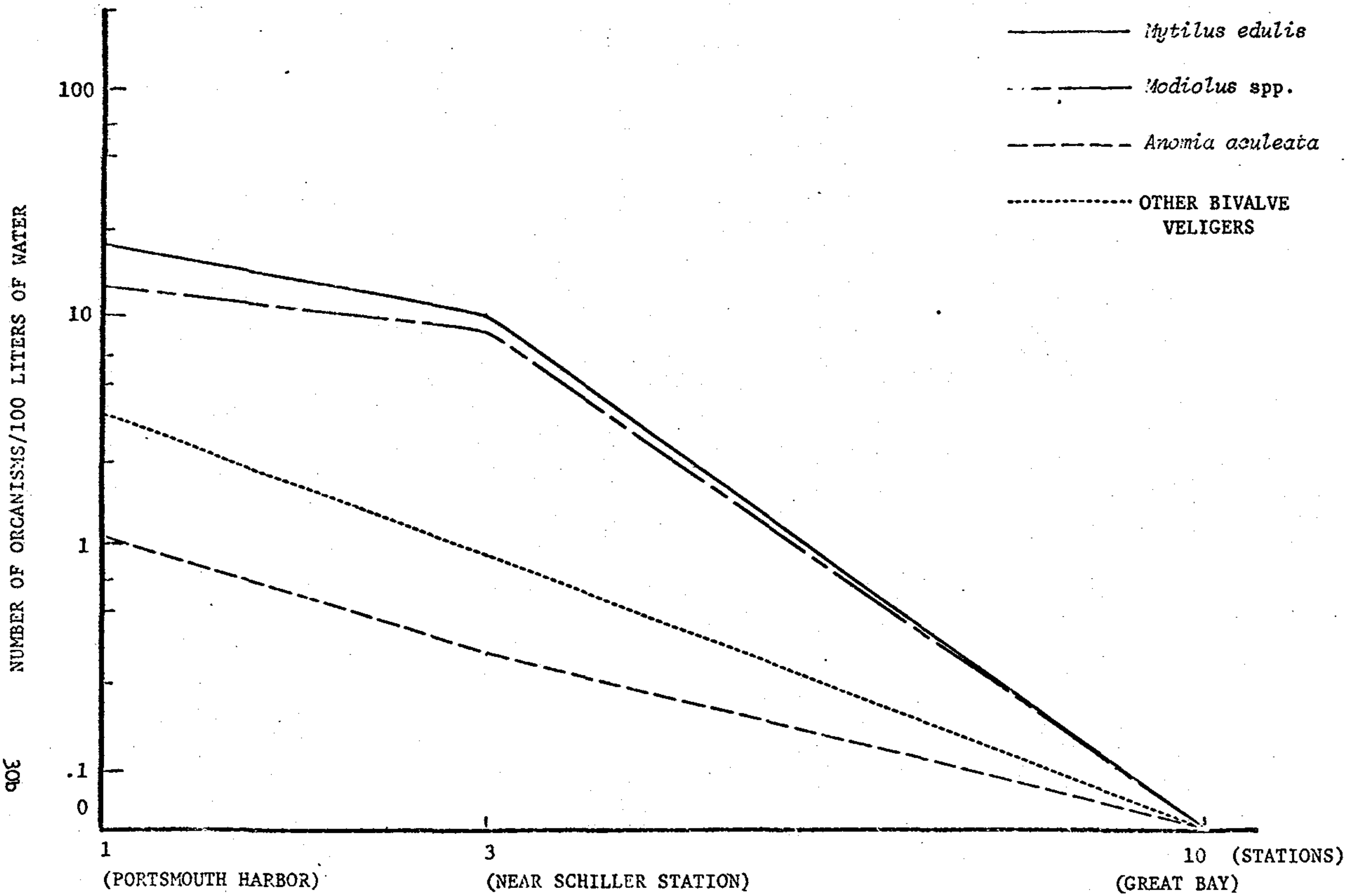

Figure 20. Distribution of bivalve larvae in the Piscataqua River Estuary, 30 October 1970, surface samples on flood tide.

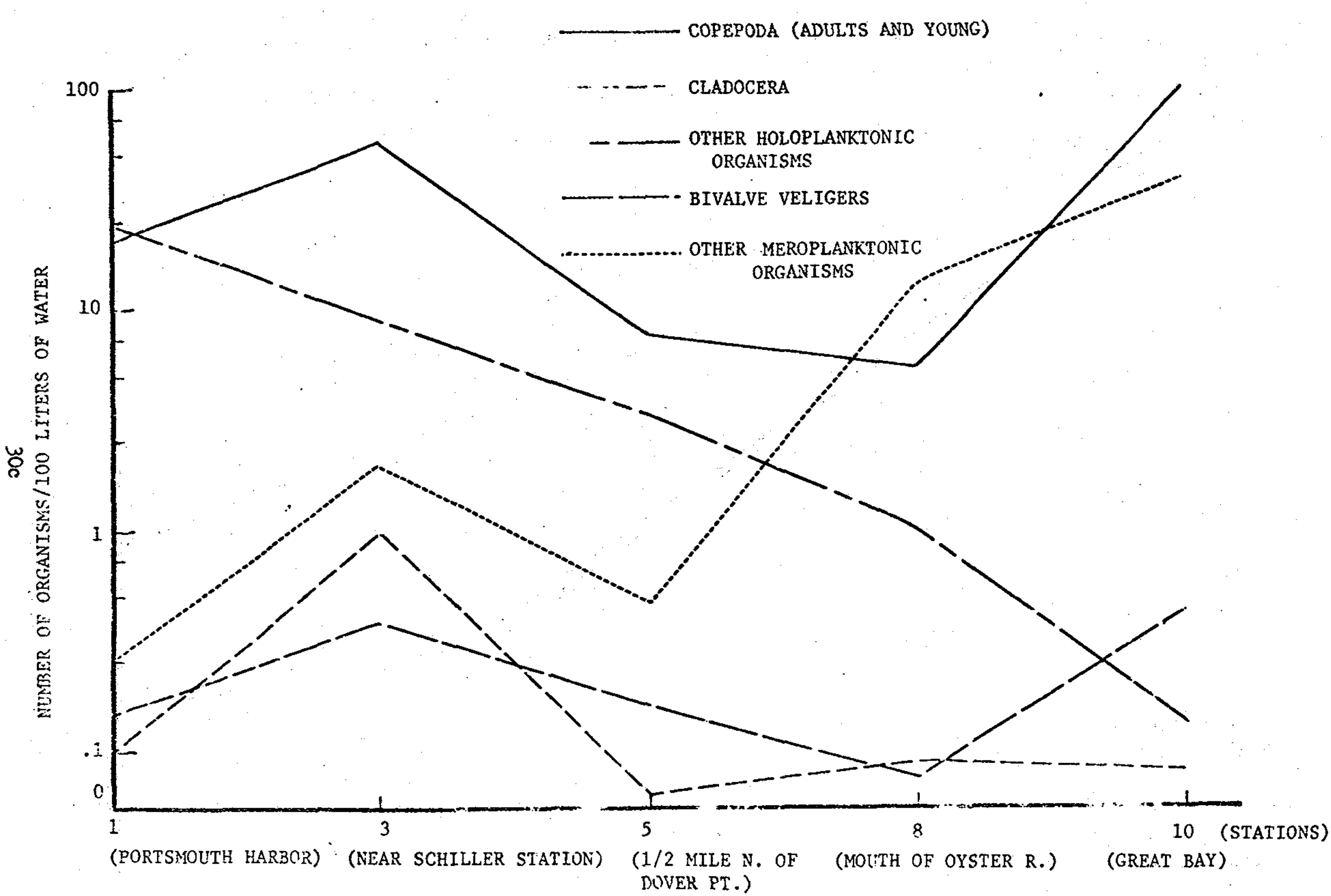

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Figure 21. Horizontal distribution of general zooplankton in the Piscataqua River Estuary system, 19 June 1970, surface samples on ebb tide.

majority of species increase in abundance slightly at Station 3, then decrease to nearly zero at Station 8. The increase in copepod numbers at Station 10 in Figure 22 is obviously due to large numbers of a single species, Acartia tonsa. Likewise, the increase in benthic invertebrate larvae at Stations 8 and 10 is due to a single large spawning of gastropods. Both bivalve larvae and other zooplankton (tunicates, chaetognaths, hydromedusae, etc.) decrease in concentration from the mouth of the estuary to Great Bay.

It is apparent from this preliminary study that a complex planktonic community exists in the Piscataqua estuarine system. Fifty-three species were identified, a number more were described to genera, and some larvae were only categorized to group. Several genera were represented by several species. This high species diversity could be indicative of a relatively stable community.

In the present study, larvae of bottom invertebrates, cladocera, tunicates, copepods and other species appeared to reach their maximum concentrations during mid-June and again in the beginning of September, then decreased in abundance sharply in November. These data are substantiated by a seasonal study of the plankton in Block Island Sound, in which it was noted that larvae of bottom invertebrates, cladocera and tunicates reached maximum population size during June, decreased sharply in August, increases in September, declined steadily during November, and finally disappeared in December. In this same study, seasonal peaks in copepod distribution occurred during January, March, June and October. Further seasonal studies are needed to define

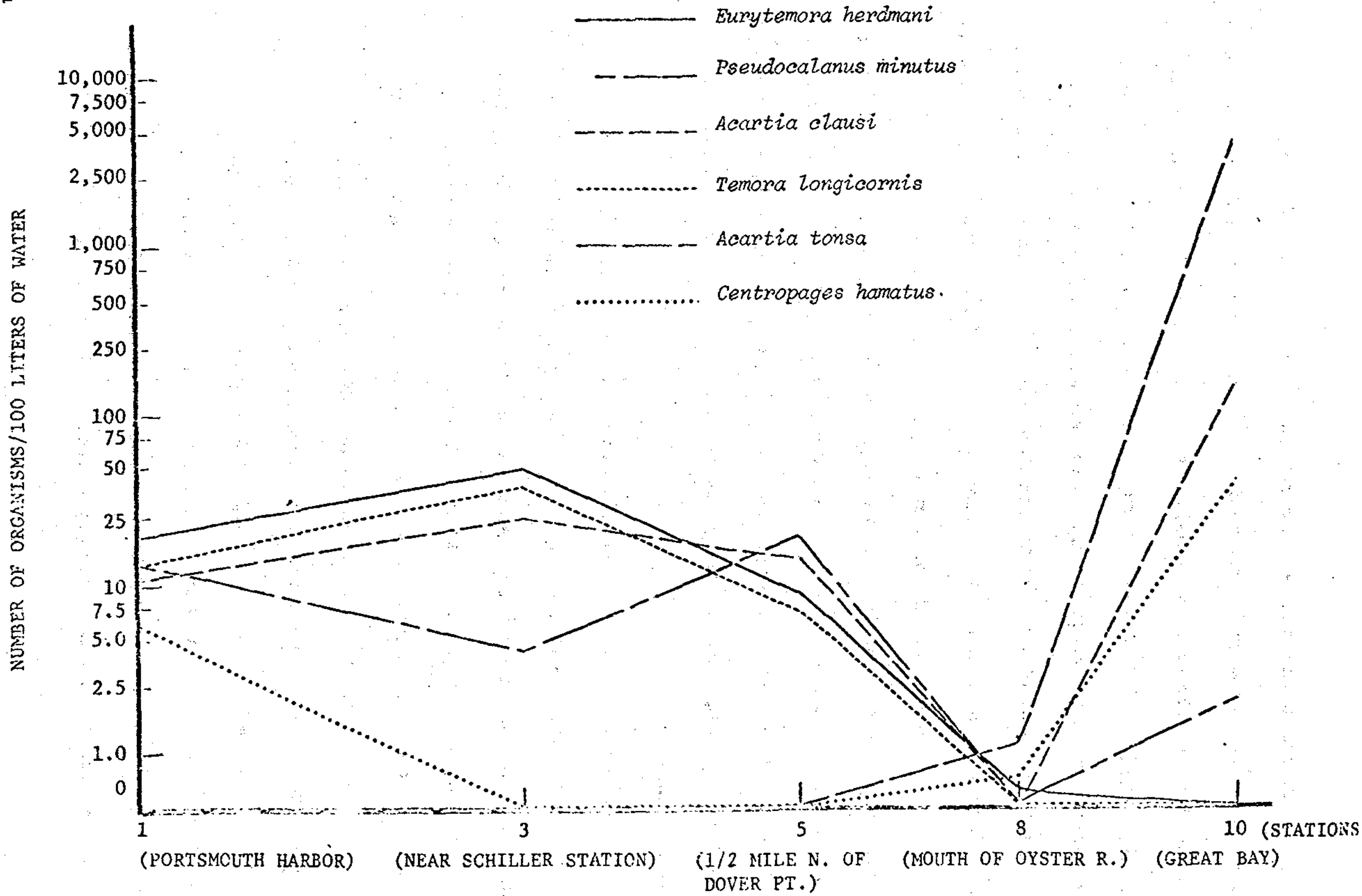


Figure 22 Distribution of selected Copepod species, 19 June 1970, surface tow, ebb tide.

the yearly fluctuation pattern for this estuary. Undoubtedly, more species are present throughout the year than were noted in the 1970 summer sampling program.

Within the estuary, planktonic species appear to be arranged in orderly aggregates. Oceanic species such as Calanus hyperboreus, C. finmarchicus, Sagitta elegans, Oikopleura dioica and Thysanoessa inermis occured in greatest abundance at the mouth of the estuary, then sharply decreased upriver. Seldom did any of these species extend beyond Station 3. In contrast, Acartia tonsa was abundant in Great Bay, but not found at any other station. Certain species appeared to occur in greater abundance in surface samples than bottom ones, and vice versa.

Nettable phytoplankton were retained by the No. 20 mesh net used for this study. Since none of the nannoplankton and quite likely some of the smaller phytoplanktonic chains were not retained, the actual standing crop is much higher than suggested by this study. However, it is readily observed that the phytoplankton are dominant in numbers.

Copepods are present in such large numbers in the plankton and reproduce so rapidly that they presumably furnish the primary food for most juvenile marine fishes and many large invertebrate organisms of various groups. The copepods Acartia clausi and P. minutus occured in abundance at most stations but decreased in the upper estuary. A. clausi occured in greatest abundance in the Piscataqua than A. longiremus and extended further up the estuary. Acartia tonsa, the species previously noted as abundant in Great Bay, is abundant in fresh, brackish and salt water in the Woods Hole Region. Temora longicornis, a persistent species in the Piscataqua River, is a littoral and neritic species which is found most frequently near shore. Centropages hamatus was another abundant copepod species collected during this study. According to previous reports, it is a brackish water, littoral and neritic species. A number of species were found to breed in the estuary during the summer: Acartia clausi, A. tonsa, Centropages hamatus, Pseudocalanus minutus, Eurytemora herdmani, Microsetella norwegica, Oithona similis and Tortanus discaudatus. It is clear from this list that the majority of copepods in the Piscataqua Estuary are not washing in from oceanic water, but are true inhabitants of this system.

The cladocera (Evandne nordmanni and E. spinifera) are indices of coastal water. Populations of the adults of all identifiable benthic invertebrate larvae were also found in the estuary.

It is apparent from the above analysis that the plankton is essentially an estuarine community quite distinct from typical marine planktonic associations.

G. Intertidal Invertebrates

Because the sampling stations in this initial survey were not intended to be compared quantitatively, only representative stations will be disucssed. Results from stations selected for pre- and post-operational monitoring will be re-analyzed and quantified for the 1971 report.

Sixty-one species of macro-invertebrates in eight phyla were collected throughout the sampling period (Table VIII). Of this total, 37 were collected between the Simplex Pier and the Schiller Generating Station.

TABLE VIII

RELATIVE ABUNDANCE OF INTERTIDAL ORGANISMS

COLLECTED BY TRANSECT SAMPLING

PISCATAQUA RIVER ECOLOGICAL STUDY

SPECIES	No. of Stations Collected	Station of Maximum Number
PHYLUM Cnidaria		
Class Hydrozoa		
Clava leptostyla	1	12
Tubularia crocea	1	52
Sertularia pumila	1	52
Thuiaria argentea	1	54
Class Anthozoa		
Edwardsia sipunculoides	1	42
PHYLUM Rhynchocoela		
Cerebratulus lacteus	5	22, 42
Lineus ruber	3	52
PHYLUM Annelida		
Class Oligochaeta		
Clitellio arenarius	4	34
Class Polychaeta		
Nereis virens	9	21
Nereis diversicolor	7	52
Nephtys caeca	4	23
Nephtys bucera	3	23, 50
Scoloplos acutus	4	12
Pectinaria gouldii	3	34
Harmothoe imbricata	1	22
Clymenella torquata	13	22
Stylaricoides arenosa	1	20
Lumbrineris tenuis	2	21
Eteone lactea	3	52
Glycera dibranchiata	1	23
Spio setosa	1	52
Amphitrite johnstoni	1	52
Spirorbis spirillum	1	52

(continued)

TABLE VIII (continued)

SPECIES	No. of Stations Collected	Station of Maximum Number
PHYLUM Mollusca		
Class Gastropoda		
Littorina littorea	29	32
Littorina obtusata	9	16
Littorina saxatilis	4	17
Lunatia heros	5	21
Lunatia triseriata	2	50
Nassarius trivittatus	4	26, 32, 34
Nassarius obsoletus	14	50
Thais lapillus	7	14
Acmaea testudinalis	2	20, 48
Hydrobia minuta	5	38
Haminoea solitaria	2	13
Lacuna vincta	1	34
Class Bivalvia		
Mytilus edulis	28	14
Mya arenaria	27	46
Macoma balthica	25	46
Tellina agilis	9	38
Gemma gemma	2	25, 32
Modiolus demissus	1	54
Crassostrea virginica	1	54
Lyonsia hyalina	1	52
Solemya velum	1	52
PHYLUM Arthropoda		
Class Crustacea - Order Decapoda		
Carcinus maenas	4	20
Crangon septemspinosus	4	23, 34
- Order Thoracica		
Balanus balanoides	9	14
Balanus improvisus	1	54
- Order Isopoda		
Idotea phosphorea	1	20
Cyathura polita	11	13
Jaera marina	1	54
- Order Amphipoda		
Jassa falcata	1	46
Gammarus oceanicus	2	12

(continued)

TABLE VIII (continued)

SPECIES	No. of Stations Collected	Station of Maximum Number
PHYLUM Arthropoda (continued)		
Class Insecta		
Anurida maritima	2	13
PHYLUM Echinodermata		
Class Asteroidea		
Asterias vulgaris	2	20, 23
Class Echinoidea		
Strongylocentrotus drobachiensis	1	19
PHYLUM Ectoprocta		
Electra hastingsae	1	54
Electra crustulenta	2	52, 54
Crisia eburnea	1	52
Flustrellidra hispida	1	54
PHYLUM Hemichordata		
Saccoglossus kowalewskii	3	13

Rocky shores were located at several points in the survey area (Stations 12, 14, 15, 18 and 54). These shores contained the typical community found on hard substrata. Community composition varied, depending on the type of rock (ledge vs. boulder) and also the extent of macro-algal covering. In general, the most common species were Littorina littorea, Littorina obtusata, Mytilus edulis and Balanus balanoides. These organisms occurred primarily from mid-water to low water, the HW zone being generally barren, with the exception of a few Littorina littorea.

The sand-mud transect (Station 25) had a community characterized by six species: Macoma balthica, Mya arenaria, Littorina littorea, Scoloplos spp., Cyathura polita and Nassarius obsoletus. This community was found consistently from low water to mid-water, and four of the species, Macoma balthica, Mya arenaria, Littorina littorea and Scoloplos spp., extended to one-half HW/MdW. The highest concentrations of Macoma balthica and Scoloplos spp. were found between the low water level and mid-water level, while Mya arenaria was most abundant at the low water level. Littorina littorea and Nassarius obsoletus occurred predominantly at one-half HW/MdW and mid-water.

A modified shingle beach (Station 17) composed primarily of pebbles, gravel and a few larger rocks intermixed with mud was devoid of macro-organisms at the upper shore except for Littorina littorea and Littorina saxatilis. With the exception of Mytilus edulis at one sample site, Littorina littorea was the most abundant organism. Macoma balthica was also found from low water to mid-water.

Stations 13 and 21 were good examples of a mud substratum. Sixteen species were found at Transect 13 and 15 species were found at Station 21, with eight common to both transects (Mytilus edulis, Littorina littorea, Mya arenaria, Macoma balthica, Nassarius obsoletus, Saccoglossus kowalewskii, Scoloplos sp. and Cyathura polita). Each transect supported large numbers of various species of mollusks, such as Macoma, and polychaetes such as Clymenella and Scoloplos.

The Schiller-Simplex shoreline generally consisted of various degrees of mud in the low water zone, mud/boulders and cobbles in the upper shore. Slopes were gradual in this area with Zostera beds extending throughout the area below the ELWS. The most abundant organisms found in the area include Littorina littorea, Mytilus edulis, Macoma balthica, Mya arenaria, and Balanus balanoides. The presence of any particular organism was determined both by the type of substratum and the location along the transect. Mya arenaria was located primarily in the middle shore where mud was usually mixed with some sand, in comparison to the very fine mud in the lower shore and the harder substrate of rock and gravel of the upper shore. Balanus balanoides was found predominately in the middle shore where rocks and boulders were encountered more frequently than in the lower shore area or the high water area. Macoma balthica was found in greatest numbers from the middle shore to low water along muddy transects. Littorina littorea ranged throughout the area, but was more common on solid substrate such as rocks and debris than on muddy flats. Mytilus edulis was another very abundant organism growing wherever there was a firm enough substrate for initial attachment. It was found predominately above the low water mark and the greatest numbers were found in the middle shore area.

Distribution of organisms varied from one location to another throughout the study area, but generally Littorina littorea, Mytilus edulis, Macoma balthica, Mya arenaria, Balanus spp., Nassarins obsoletus and various species of polychaetes such as Clymenella torquata and Nereis spp. were found in the majority of samples. No significant concentrations of commercially important organisms were observed in the area between the General Sullivan Bridge in Newington and the Maine-New Hampshire Toll Bridge in Portsmouth. Mya arenaria, while occurring in the majority of the samples, was not abundant at any station. The American oyster, Crassostrea virginica, was not found in the above mentioned survey area, either as spat or adults. However, a transect in Great Bay indicated oysters living there. Adults and spat were noted on the transect about the low water mark and in the general area of the transect. Populations of Crassostrea virginica were also noted in the Spinney Creek region of the Piscataqua River, and the Maine Sea and Shore Fisheries maintains culture rafts in this area of spat settlement. Spat settlement was reported to have been moderate in the Spinney Creek area for 1970 and further studies may indicate the ability of the study area to support a viable oyster population using the Spinney Creek oysters as parental stock.

H. Subtidal Benthic Invertebrates

The 1970 benthic studies were conducted to develop an inventory of the sublittoral benthos living in the Piscataqua River Estuary, and to determine the distribution and relative abundance of each species. The survey was primarily conducted in an area extending from the General Sullivan Bridge in Newington to the Maine-New Hampshire Bridge in Portsmouth, with additional samples taken in Little Bay and Great Bay. Benthic stations are listed below in Table IX.

TABLE IX

STATIONS SAMPLED DURING THE SUBTIDAL BENTHIC SURVEY

Date	Station		Date	Station	
July 1970	12	25	August 1970	10	28A
	13	26		12	30
	15	26A		13	30A
	16	30		14	32
	17	30A		16	32A
	18	34		17	34
	18A	34A		18	34A
	19	38		18A	36
	20	38A		19	36A
	20A	42		20	38
	21	42A		20A	38A
	22	44		21	40
	22A	44A		22	40A
	23	46		22A	42
	24	48		23	42A
	24A	50		24	44
				24A	44A
				25	46
				26	48
				26A	50
				28	52A

Stations without the letter designation - 300' from high water mark.
Station with the letter designation "A" - 500' from high water mark.

The sampling area of interest exhibits considerable heterogeneity of bottom composition (Table X). Substratum composition ranges from rock outcrop to mud. Comparison of Tables IX and X indicates no obvious relationship between bottom composition of a station and its species diversity rank. Stations of both high and low species diversity rank are to be found within each of the bottom type classifications.

Several additional epibenthic species not found in the grab sampling were collected through other sampling techniques. Conversations with local lobstermen indicated populations of the American lobster, *Homarus americanus*, and rock crabs, *Cancer* spp., living in the estuary during the summer months. *Mysis stenolepis* was collected in the epibenthic trawl, while diving observations determined the presence of *Limulus polyphemus*, *Pagurus longicarpus*, *Ampelisca* spp. and various species of sponges.

TABLE X
SUBSTRATUM TYPES

PISCATAQUA RIVER BENTHOS STUDY

BOTTOM TYPE (as determined from inspection of grab contents)	SAMPLING STATIONS
A. Rock outcrop	14
B. Mixture of rocks and various grades of sediment	12, 15, 16, 17, 18A, 20A, 28, 32, 36A
C. Coarse sand	19, 22, 22A, 24A, 26A, 28A, 30A, 32A, 34A, 38A, 42, 42A, 44A
D. Fine sand	50
E. Mixture of fine sand and mud	18, 20, 26, 34, 36, 40, 40A, 46, 48
F. Mud	13, 21, 23, 24, 25, 30, 38, 44, 52A, 10

One hundred thirty-nine macro-invertebrate species representing 11 phyla were collected throughout the study area during July and August of 1970. Of these, 112 species belonging to ten phyla were found in the Schiller-Simplex area. The distribution and relative abundance of each species is presented in Table XI. Each animal is listed under the appropriate higher taxon. The first two columns to the right of the species listing relate to the animal's distribution within the study area. The first column indicates the number of sampling stations, out of a possible 41, at which the animal was collected during the entire study period, irrespective of month (i.e., distinction was not made as to whether the animal was collected in July, August, or both). Each species was next assigned an arbitrary "distribution index" based on the data from the first column. Species collected from five or fewer stations were considered as "narrowly distributed" and were assigned the letter "N" in the second column of Table XI. Species collected from six to ten of the stations were considered "slightly dispersed" in terms of their distribution patterns and were assigned the letter index "S". Species collected from 11 to 20 stations were considered to be "extremely distributed" and were assigned the letter index "E". Finally, those species occurring in more than 20 stations were considered "widespread" and assigned the letter index "W".

The third and fourth columns of Table XI deal with the maximum numerical abundance of each species encountered during the entire study period (i.e., irrespective of the month). The third column indicates the station(s) within the study area which had (have) the highest mean

TABLE XI

PISCATAQUA RIVER ECOLOGICAL STUDY
1970 SPECIES DISTRIBUTION AND ABUNDANCE

SPECIES	No. of Stations Encountered	Distribution Index	Station of Maximum Abundance	Mean/Grab at Station of Maximum Abundance
PHYLYM Porifera				
Cliona celata	3	N	22A, 32A	0.33
Halichondria bowerbanki	1	N	17A	0.33
Halichondria panicea	7	S	14A	1.00
Haliclona loosanoffi	1	N	16A	0.33
Haliclona oculata	2	N	22A, 28A	0.33
Leucosolenia sp.	1	N	30A	0.33
PHYLUM Cnidaria				
Class Hydrozoa				
Thuiaria argentea	9	S	18A	1.00
Calycella syringa	1	N	26A	0.33
Campanularia flexuosa	1	N	18A	0.33
Clava leptostyla	2	N	16	0.50
Sertularia pumila	9	S	42A	1.33
Tubularia crocea	9	S	14A	1.00
Tubularia larynx	1	N	17A	0.33
Class Anthoza				
Edwardsia sipunculoides	9	S	12A	3.67
Haliplanella luciae	2	N	20A	2.00
Metridium senile	1	N	17	0.33
PHYLUM Platyhelminthes				
Class Turbellaria				
Notoplana atomata	1	N	18	0.33

(continued)

TABLE XI (continued)

SPECIES	No. of Stations Encountered	Distribution Index	Station of Maximum Abundance	Mean/Grab at Station of Maximum Abundance
PHYLUM Rhynchocoela				
Amphiporus sp.	1	N	44	0.33
Cerebratulus lacteus	2	N	12, 34	0.33
Lineus ruber	3	N	42	0.67
Tetrastemma wilsoni	2	N	48	0.33
PHYLUM Annelida				
Class Polychaeta				
Amphitrite johnstoni	2	N	34, 36	0.33
Clymenella torquata	25	W	12	19.33
Clymenella zonalis	18	E	26	3.67
Eulalia viridis	3	N	20, 26A, 42A	0.33
Glycera dibranchiata	1	N	32A	0.33
Goniada gracilis	1	N	44A	1.33
Harmothoe extenuata	7	S	34	1.00
Harmothoe imbricata	11	E	36A, 42A	1.67
Lepidonotus squamatus	19	E	13, 38	3.33
Lumbrineris tenuis	19	E	32, 34, 36	3.67
Nephtys bucera	17	E	40	1.67
Nephtys caeca	27	W	12	7.33
Nereis diversicolor	6	N	21	2.67
Nereis pelagica	2	N	14	1.00
Nereis virens	4	N	21	1.67
Pectinaria gouldii	18	E	18, 40	2.00
Phyllodoce groenlandica	2	N	24	0.33
Scolelepis squamata	2	N	24A, 34A	0.67
Scolecolepides viridis	4	N	34A	2.67
Scoloplos acutus	4	N	21	2.67
Spio setosa	2	N	24	0.33
Spirorbis borealis	5	N	22A	100.00
Sternaspis fossor	1	N	48	0.67
Travisia carnea	1	N	44A	0.33
Trophonia affinis	1	N	34	0.33
Spirorbis spirillum	12	E	38	36.67

(continued)

TABLE XI (continued)

SPECIES	No. of Stations Encountered	Distribution Index	Station of Maximum Abundance	Mean/Grab at Station of Maximum Abundance
PHYLUM Anneiida (continued)				
Class Oligochaeta				
Clitellio arenarius	1	N	38A	6.33
PHYLUM Mollusca				
Class Gastropoda				
Acmaea testudinalis	4	N	42	0.67
Crepidula fornicata	1	N	20	0.33
Crepidula plana	1	N	30	0.67
Dendronotus frondosus	1	N	24A	0.33
Haminoea solitaria	2	N	21	1.67
Hydrobia minuta	14	E	48	51.33
Lacuna vincta	1	N	22	0.33
Littorira littorea	19	E	42	9.67
Littorina obtusata	9	S	44	2.67
Lora bicarinata	1	N	13	0.33
Lunatia heros	7	S	18, 50	0.67
Lunatia triseriata	33	W	36A	14.33
Mitrella lunata	5	N	19	0.67
Nassarius obsoletus	6	N	23	14.33
Nassarius trivittatus	15	E	22	2.33
Odostomia bisuturalis	1	N	25	0.33
Onchidoris muricata	2	N	36	0.33
Thais lapillus	2	N	18	0.67
Urosalpinx cinerea	1	N	10	0.20
Class Pelycepoda				
Anomia aculeata var. *ephippium*	1	N	18A	0.33
Anomia aculeata	6	S	24	1.00
Astarte castanea	6	S	32	1.00
Astarte undata	14	E	18A	4.33
Cerastoderma pinnulatum	17	E	12	2.33
Crenella glandula	4	N	17	0.67
Ensis directus	7	S	12	3.67
Gemma gemma	8	S	21	7.00
Hiatella arctica	8	S	16	4.00

(continued)

TABLE XI (continued)

SPECIES	No. of Stations Encountered	Distribution Index	Station of Maximum Abundance	Mean/Grab at Station of Maximum Abundance
PHYLUM Mollusca (continued)				
Class Pelycepoda				
Lyonsia hyalina	17	E	42A	2.33
Macoma balthica	9	S	23	39.67
Mercenaria mercenaria	3	N	12, 30	0.33
Modiolus modiolus	10	S	22	37.33
Mulinia lateralis	1	N	10	0.20
Musculus niger	5	N	42A	0.67
Mya arenaria	16	E	23	17.33
Mytilus edulis	17	E	25	800.00
Nucula delphinodonta	5	N	42	0.67
Petricola pholadiformis	2	N	12	1.33
Solemya velum	1	N	52	0.60
Spisula solidissima	3	N	32A	1.00
Tellina agilis	18	E	44	8.67
Class Amphineura				
Tonicella ruber	1	N	22A	0.33
PHYLUM Arthropoda				
Class Crustacea - Order Decapoda				
Cancer irroratus	3	N	50	0.67
Carcinus maenas	1	N	17	0.33
Crangon septemspinosus	4	N	13, 46, 48	0.33
Pagurus longicarpus	1	N	48	0.33
Pagurus bernhardus	1	N	26A	0.33
Rhithropanopeus harrissi	1	N	36A	0.33
- Order Isopoda				
Chiridotea coeca	11	E	38A	3.33
Chiridotea tuftsi	2	N	21	0.33
Cyathura polita	1	N	52	0.20
Edotea triloba	1	N	36	0.33
Idotea baltica	1	N	22	0.33
Idotea phosphorea	26	W	15, 16, 19	3.00
Jaera marina	1	N	17	0.33

(continued)

TABLE XI (continued)

SPECIES	No. of Stations Encountered	Distribution Index	Station of Maximum Abundance	Mean/Grab at Station of Maximum Abundance
PHYLUM Arthropoda (continued)				
Class Crustacea - Order Cumacea				
Oxyurostylis smithi	1	N	52	0.40
- Order Amphipoda				
Acanthohaustorius millsi	1	N	28A	0.33
Ampelisca abdita	1	N	26A	0.33
Ampelisca vadorum	31	W	24A	38.67
Ampithoe rubricata	1	N	26A	0.33
Ampithoe valida	3	N	40A, 44	1.00
Corophium volutator	6	S	44A	1.00
Gammarus oceanicus	2	N	22	0.67
Jassa falcata	4	N	19	1.33
Leptocheirus sp.	19	E	12	10.67
Phoxocephalus holbolli	1	N	26A	0.33
Tmetonyx sp.	1	N	26A	0.33
Tryphosella sp.	1	N	26A	0.33
Unciola irrorata	21	W	42A	15.67
PHYLUM Ectoprocta				
Bugula turrita	1	N	46	0.33
Callopora aurita	14	E	18A	1.00
Crisea eburnea	22	W	14, 18A	1.00
Cryptosula pallasiana	1	N	10	1.00
Electra crustulenta	15	E	15	1.00
Electra hastingsae	9	S	18	1.00
Electra pilosa	6	S	all equal	0.33
Flustrellidra hispida	1	N	30A	0.33
Hippothoa hyalina	12	E	all equal	0.33
Membranipora sp.	4	N	18A, 22A, 38, 20A	0.33
Microporella ciliata	3	N	18A	1.00

(continued)

TABLE **XI** (continued)

SPECIES	No. of Stations Encountered	Distribution Index	Station of Maximum Abundance	Mean/Grab at Station of Maximum Abundance
PHYLUM Echinodermata				
Class Asteroidea				
Asterias forbesi	8	S	14	5.00
Asterias vulgaris	26	W	20A	4.33
Henricia sanguinolenta	6	S	15	1.00
Class Echinoidea				
Echinarachnius parma	14	E	12	4.00
Strongylocentrotus drobachiensis	16	E	19	3.33
Class Ophiuroidea				
Amphipholis squamata	7	S	22	4.00
Ophiopholis aculeata	2	N	13, 20	0.33
PHYLUM Hemichordata				
Saccoglossus kowalewskii	1	N	25	0.33
PHYLUM Chordata				
Subphylum Urochordata				
Botryllus schlosseri	3	N	22, 22A, 24	0.33
Molgula complanata	5	N	34	13.33
Molgula manhattensis	1	N	36	0.33

N - Narrowly distributed
E - Extremely distributed
S - Slightly dispersed
W - Widespread

number of species per grab for the species listed on the left. The fourth column gives this mean value.

Close inspection of Table XI reveals several features relevant to the distirbution and maximum abundance of the animals encountered during the study period. Approximately 58% of the animals collected were "narrowly distributed" (i.e., the animals were collected at five or fewer stations). Approximately 30% of all species were collected from only one station of the 41 sampled. Of the 139 different animals collected, only the following seven (4.7% of the total) were "widespread" (i.e., occurred at more than 20 of the 41 stations):

Ampelisca vadorum	_Crisea eburnea_
Asterias vulgaris	_Idotea phosphorea_
Clymenella torquata	_Nephtys caeca_
Lunatia triseriata	

The list of "widespread" animals includes not only highly vagile, epifaunal types, but also several sedentary or sessile animals which are adapted for habitation in various sediment grades.

The information given in the third and fourth columns of Table VIII allows one to easily pick out those animals found in either high or low average numbers in grab samples. Only 15% of all species collected have a mean number of specimens per grab greater than five at any sampling station. The following eight animals showed the highest mean number of specimens collected per grab, (more than 19) during the study period:

Ampelisca vadorum	_Modiolus modiolus_
Clymenella torquata	_Mytilus edulis_
Hydrobia minuta	_Spirorbis borealis_
Malcoma balthica	_Spirorbis spirillum_

Only two animals, Ampelisca vadorum and Clymenella torquata, are common to both lists (i.e., combine the characteristics of being both widespread and present in maximum mean number of specimens per grab greater than 19 at any station).

A total of 41 stations were sampled within the study period. It was desirable to have an index, although a crude one, which serves to compare the sampling stations with respect to species diversity. The following procedure was used for ranking the stations according to the number of species encountered at each:

1. The number of species present at a given station was used to determine its diversity rank; and
2. In those cases where a station was sampled both in July and August, the higher species number, irrespective of the month, was selected for the determination of the diversity rank of that station.

The resultant scheme of species diversity is presented in Table XII. In general, Table IX illustrates that the majority of animals collected consisted of species which were "narrowly distributed" and have maximum densities at any one station of less than five specimens per grab. It is interesting to note that the Schiller-Simplex area (Figure, page 8) proved to be consistently high in species diversity. Eight sampling stations in this area contained at least 25 species.

TABLE XII

BETWEEN- STATIONS SPECIES DIVERSITY RANKING

Station Number	Maximum Number of Species Present	Numerical Rank	Station Number	Maximum Number of Species Present	Numerical Rank
36	32	1.0	17	17	18.0
42	29	2.0	40	17	18.0
26A	28	3.5	40A	16	24.5
38	28	3.5	50	16	24.5
20	27	5.0	26	16	26.0
13	26	8.2	18A	15	27.0
22	26	8.2	19	15	27.0
24A	26	8.2	46	15	27.0
12	26	8.2	32	14	30.5
24	26	8.2	48	14	30.5
52A	25	11.5	21	13	32.0
42A	25	11.5	25	12	34.0
38A	23	13.0	28	12	34.0
34	20	14.5	15	12	34.0
36A	20	14.5	16	11	36.0
20A	19	16.0	34A	10	37.0
30	18	17.0	14	8	38.0
10	17	18.0	23	8	38.0
22A	17	18.0	30A	8	38.0
44	17	18.0	32A	7	41.0
18	17	18.0	28A	6	42.0
			44A	2	43.0

I. Epifaunal Fouling Organisms

No quantitative results have been obtained from the preliminary study, but an abundance of fouling organisms was observed. Diatoms were the most consistently abundant organism, with higher population densities in summer and lower in winter. Large populations of hydroids, particularly Tubularia crocea, formed a dense shelter during the summer in which nematodes, copepods, amphipods, and polychaetes lived. Spat from several species of bivalves were present in August. In most cases the soft pine panels supported a denser concentration of organisms than the hard pine, but the species composition was similar for both wood types. Preliminary data recovered from August, 1970 through February, 1971 is listed below.

EPIFAUNAL FOULING ORGANISMS AT STATION 3A

DATE COLLECTED	ORGANISMS	QUANTITY
August 6, 1970		
Soft Pine Panel	*Tubularia crocea*	Abundant
	Gastrotrichs	Common
	Amphipods	Few
	Mytilus spat	Rare
	Modiolus spat	Rare
	Polychaete	Rare
	Algae	Abundant
	Diatoms	Abundant
	Copepods	Abundant
August 6, 1970		
Hard Pine Panel (predominately on sides of panel)	Diatoms	Common
	Gastrotrichs	Rare
	Mytilid spat	Rare
	Copepods	Few
August 26, 1970		
Soft Pine Panel	*Tubularia crocea*	Common
	Tubularia larynx	Common
	Algal growth	Few
	Mytilus juveniles	Common
	Modiolus juveniles	Few
	Amphipods	Common
	Colonial diatoms	Abundant
	Copepods	Common

(continued)

DATE COLLECTED	ORGANISMS	QUANTITY
October 30, 1970		
Hard Wood	Nematodes	Few
	Diatoms	Common
	Copepods	Abundant
	Mytilids	Rare
	Rotifers	Rare
October 30, 1970		
Soft Wood	Nematodes	Common
	Copepods	Common
	Rotifers	Few
	Diatoms	Common
November 30, 1970		
Soft Wood	Diatoms (colonial)	Abundant
	Nematodes	Abundant
	Copepods	Abundant
	Tubularia crocea	Rare
	Turbellaria	Abundant
	Idotea phosphorea	Rare
	Hydrobia minuta	Rare
	Diatoms (solitary)	Few
	Amphipods	Few
November 30, 1970		
Hard Wood	*Idotea phosphorea*	Rare
	Diatoms (colonial)	Abundant on sides
	Copepods	Abundant
	Amphipods	Few
	Nematodes	Abundant
	Turbellaria	Few
January 8, 1971		
Soft Wood	Diatoms (colonial)	Abundant
	Green algae	Few
	Copepods	Few
January 8, 1971		
Hard Wood	Diatoms (colonial)	Common on sides
	Copepods	Few
	Green algae	Rare
February 2, 1971		
Soft Wood	Diatoms	Few
	Copepods	Rare
February 2, 1971		
Hard Wood	Diatoms	Few on sides

ABUNDANT: 50% and up of Block FEW: Less than 20% of Block
COMMON: 20-50% of Block RARE: Less than 5% of Block

J. Benthic Marine Algae

A total of 49 taxa of seaweeds were collected at the seven stations, including 27 Rhodophyceae (red algae), 11 Phaeophyceae (brown algae), 10 Chlorophyceae (green algae), and one Bacillariophyceae (colonial diatom). An evaluation of the Cyanophyceae (blue-green algae) and Xanthophyceae (yellow-green algae) was beyond the scope of the present investigation, but will be summarized in the future. Details of species composition and distribution are summarized in Tables XVII through XIX. Eighteen of the 27 taxa of red algae (i. e., 66%) were perennial forms. A similar trend was evident with the brown algae, for most (64%) were perennials. In contrast, most (80%) of the green algae were annuals. The colonial diatom, *Amphipleura rutilans*, is also an annual.

The intertidal areas of each station were primarily composed of scattered rock outcrops, boulders, pebbles, shells or artificial substrates, amidst a muddy, flat shore line. The largest amount of solid rock was usually evident in the upper intertidal zone and the shores tended to grade into muddy areas in the lower intertidal - upper subtidal zones. Stations 16 and 17 have the most rock substratum. A buildup of peat-like material, from *Spartina* spp., was evident at Stations 19 and 44. The roots of *Spartina* spp. stabilize muddy surfaces and provide attachment for plants and animals (e. g., *Balanus balanoides*), which otherwise would not be present.

The subtidal areas at most stations (except Station 16) were primarily composed of muddy surfaces with scattered boulders, small rocks, shells and/or bricks. In most cases the solid substrata was either coated with a thin film of silt or a deeper coating of mud. In contrast, Station 16 was primarily composed of massive boulders which were free of sediments due to the strong tidal currents at the location.

An analysis of the species listed in Tables XIII through XV indicates that most taxa occur on the adjacent open coast and within the estuary. In other words, they exhibit a cosmopolitan distribution. Even so, many of the latter species (particularly the red algae) grow best on the open coast, and they are present in reduced quantities or as dwarfed plants near the Schiller Power Plant. Examples which can be cited are *Ahnfeltia plicata*, *Clathromorphum circumscriptum*, *Cystoclonium purpureum* var. *cirrhosum*, *Gigartina stellata*, *Petrocelis middendorfii*, *Phycodrys rubens*, *Phymatolithon lenormandii*, *Phyllophora* spp., *Polyides caprinus*, *Laminaria digitata*, *Monostroma fuscum* and *Protoderma marinum*. It is apparent that the brown and green algae represented in the collections tend to be more flexible to estuarine conditions than the red algae.

Factors Influencing the Local Occurrence of Seaweeds

The primary factors influencing the local distribution of seaweeds near the Newington site are threefold, as follows:

1. the variety and abundance of solid substratum,
2. seasonal and diurnal fluctuations of hydrographic conditions, and
3. the occurrence of tidal rapids.

The stability of rocks is of major importance in restricting the growth and abundance of seaweeds near the Schiller site. Thus, small cobbles

TABLE XIII

SPECIES COMPOSITION, LONGEVITY AND DISTRIBUTION OF RHODOPHYCEAE

SPECIES	STATIONS 16	17	19	26	30	34	44	Longevity	Estuarine Distribution	Vertical Distribution
Rhodophyceae										
Ahnfeltia plicata	X				X	X		P	C	S
Antithamnion sp.	X	X		X	X			A	?	S
Antithamnion plumula		X					X	A	E?	S
Callithamnion sp.				X			X	A	?	S
Ceramium rubrum	X	X	X	X	X	X	X	P	C	S
Ceramium strictum							X	A	E	S
Chondrus crispus	X	X		X	X	X	X	P	C	I & S
Clathromorphum circumscriptum	X	X		X	X	X		P	C	S
Cystoclonium purpureum var. *cirrhosum*	X					X	X	P	C	S
Dumontia incrassata	X							A	C	I
Gigartina stellata	X						X	P	C	I & S
Hildenbrandia prototypus	X	X	X	X	X	X	X	P	C	I & S
Lomentaria orcadensis	X	X		X	X		X	A	C	S
Petrocelis middendorfii		X			X	X	X	P	C	I & S
Peyssonelia rosenvingi	X							P	C	S
Phycodrys rubens	X	X		X		X	X	P	C	S
Phymatolithon lenormandii	X	X		X	X	X		P	C	S
Phyllophora brodiaei					X		X	P	C	S
Phyllophora membranifolia	X	X		X	X	X		P	C	S
Polysiphonia elongata	X	X	X	X	X	X	X	P	E	S
Polysiphonia harveyi		X			X	X		A?	E?	S
Polysiphonia nigra	X	X		X	X			P?	C	S
Polysiphonia nigrescens	X				X	X	X	P	C	S
Polyides caprinus	X	X			X			P	C	S
Porphyra leucosticta						X	X	A	C	I & S
Porphyra umbilicalis		X			X		X	A	C	I
Rhodymenia palmata	X	X			X		X	P	C	S

A = Annual; P = perennial; C = Cosmopolitan; E = Estuarine I = Intertidal; S = Subtidal

TABLE XIV

SPECIES COMPOSITION, LONGEVITY AND DISTRIBUTION OF PHAEOPHYCEAE, CYANOPHYCEAE AND XANTHOPHYCEAE

SPECIES	STATIONS 16	17	19	26	30	34	44	Longevity	Estuarine Distribution	Vertical Distribution
Phaeophyceae										
Ascophyllum nodosum	X	X		X	X			P	C	I
Ascophyllum nodosum f. *scorpioides*	X							P	E	I
Chorda filum							X	A	C	S
Ectocarpus siliculosus					X	X	X	A	C	I & S
Fucus vesiculosus var. *spiralis*	X	X	X	X	X	X		P	E	I
Laminaria digitata	X	X						P	C	S
Laminaria saccharina	X	X		X	X	X	X	P	C	S
Petalonia fascia	X			X		X		A	C	I
Ralfsia borneti	X					X		P	C	I & S
Ralfsia verrucosa		X	X			X	X	P	C	I & S
Scytosiphon lomentaria	X			X		X	X	A	C	I
Cyanophyceae										
Various blue-green algae							X	?	?	I
Xanthophyceae										
Vaucheria sp.							X	?	E	I
Bacillariophyceae										
Amphipleura rutilans		X					X	A	C	I

A = Annual; P = perennial; C = Cosmopolitan; E = Estuarine; I = Intertidal; S = Subtidal

TABLE XV

SPECIES COMPOSITION, LONGEVITY AND DISTRIBUTION OF CHLOROPHYCEAE

SPECIES	STATIONS 16	17	19	26	30	34	44	Longevity	Estuarine Distribution	Vertical Distribution
Chlorophyceae										
Cladophora sericeae	X			X		X		A	C	I
Chaetomorpha linum	X	X		X	X	X	X	P?	C	I & S
Enteromorpha erecta		X	X			X	X	A	C	I
Enteromorpha intestinalis							X	A	C	I
Enteromorpha linza	X	X	X			X	X	A	C	I & S
Monostroma fuscum		X		X	X	X	X	A	C	I & S
Monostroma oxyspermum							X	A	E	I
Protoderma marinum	X	X	X	X	X	X	X	P	C	I & S
Rhizoclonium riparium			X				X	A	C	I
Ulva lactuca	X		X			X	X	A	C	I & S

A = Annual; P = perennial; C = Cosmopolitan; E = Estuarine; I = Intertidal; S = Subtidal are unsuitable for many larger plants, for they will be crushed and damaged. Larger boulders and granitic outcrops exhibited the most diverse floras. Crustose algae (e.g., Hildenbrandia prototypus and Protoderma marinum) were the only abundant forms on mobile, cobble-like rocks. Very few algae, except the colonial diatom, Amphipleura rutilans, were found on muddy surfaces. It was apparent that films of silt and/or mud inhibited the growth and attachment of many species.

Conspicuous fluctuations of temperature and salinity (both daily and seasonal) are evident in the vicinity of the Schiller Generating Station. Such fluctuations restrict the diversity and abundance of species, as compared to adjacent open coastal sites. Hence, many coastal species (e. g., Alaria esculenta) do not occur within the Great Bay Estuary system, presumably because they require a more stable environmental regime. Other species which are most flexible (e.g., Ascophyllum nodosum and Laminaria saccharina) occur on the open coast and within the estuary, including the Schiller plant site. Such species can be referred to as cosmopolitan species. The longevity and viability of cosmopolitan species varies significantly. Thus, some of the latter species (e. g., Phycodrys rubens, Phyllophora brodiaei and Clathromorphum circumscriptum) show maximum abundance and growth on the open coast, and they are either reduced in size or uncommon in estuarine areas, such as the Piscataqua River. In contrast, other cosmopolitan species, such as Ascophyllum nodosum, Laminaria saccharina and Chondrus crispus, do not show any substantial reduction in abundance or stature within the estuary. Certain components of the estuarine flora found near the Shiller site have affinities toward warm temperature regions; in particular, the summer annuals whose center of distribution is south of New England (e. g., Lomentaria orcadensis and Dasya pedicellata). Such species occur in localized bays and estuaries in the northeast, where insolation and shallow depths allow very high summer temperatures (20° to 25° C), i.e., relative to other northern New England sites.

Another major floristic component of the estuary is composed of true estuarine species. The latter forms seem to require continual fluctuations of hydrographic conditions. Typical examples found near the Newington Plant site are Dasya pedicellata, Polysiphonia elongata, P. subtilissima and Monostroma oxyspermum.

Pronounced tidal rapids are evident near the Schiller Station, particularly at Station 16. Tidal currents are conspicuous in many narrow channels which are situated in front of bay-like regions. Thus, the fastest currents will be associated with the narrowest channels. Tidal currents exert a major influence on the growth, composition and distribution of organisms in the Piscataqua River. Some species, such as Chaetomorpha linum and Cladophora sericeae exhibit an increase in size and total biomass due to currents. The algal vegetation in a rapid tidal and (such as Station 15) has an "open coastal" character, as compared to adjacent areas lacking currents that are dominated by estuarine vegetation. According to Previous studies, tidal currents are analogous to wave action, for they prevent deposition of sediments, reduce local extremes of temperature and oxygen and exert a strong mechanical pull.

A comparison of the vertical distribution (intertidal versus subtidal) of taxa summarized in Tables XVII through XIX indicates that most of the red algae (75%) were restricted to the subtidal zone. In contrast, only three species of brown algae (_Chorda filum_, _Laminaria digitata_ and L. saccharina) and no green algae were restricted to the subtidal zone. _Ectocarpus confervoides_, _Ralfsia borneti_, _R. verrucosa_, _Chaetomorpha linum_, _Enteromorpha linze_, _Monostroma fuscum_ and _Ulva lactuca_ were most abundant in the subtidal zone, but they also occurred occasionally in the lower intertidal zone. _Protoderma marinum_ was most abundant in the mid to lower intertidal zones and it extended into the upper subtidal zone. It is apparent that the subtidal flora near the Newington site is much more diverse than the intertidal flora. The importance of direct observations and collections (by SCUBA) cannot be over-emphasized if an adequate floristic record is to be made. A comparison of the longevity of each taxa and its vertical distribution shows that the subtidal zone is dominated by perennial species. Even though annuals are abundant in the intertidal zone, some of the dominant intertidal species (e.g., _Ascophyllum nodosum_, _A. nodosum_ f. _scorpioides_ and _Fucus vesiculosus_ var. _spiralis_) are prennials.

Plant Associations

The term "association" is variously defined by different ecologists. In the context of this account, we shall simply use it to designate those organisms which tend to grow together under similar environmental regimes. The following plant associations can be distinguished near the Newington Station site.

1. _Spartina_ - green algae association
2. _Ascophyllum_ - Fucus association
3. _Chondrus_ - annual red algae association

4. *Laminaria* association

5. *Zostera marina* association

The *Spartina* - green algae association is conspicuous in the upper fringes (muddy) of New England salt marshes. It is dominated by *Spartina alterniflora* and *S. patens*, which are flowering plants, as well as *Enteromorpha erecta*, *E. intestinalis*, *Rhizoclonium riparium*, *Vaucheria* sp. and various blue-green algae. The fucoid algae *Ascophyllum nodosum forma scorpioides* may be locally abundant amongst fronds of *Spartina* spp. *Monostroma oxyspe rmum* may also exhibit a similar localized abundance, particularly in brackish water areas. The *Spartina* - green algae association was best develpped at Station 19, but even here relatively few flowering plants (e.g., *Atriplex partula* var. *hastatum* and *Limonium nashii*) were evident. The latter species are conspicuous in the Hampton-Seabrook Estuary.

The *Ascophyllum nodosum* - *Fucus vesiculosus* var. *spiralis* association is one of the most characteristic intertidal associations of the Great Bay estuary system. The availability of substratum is the primary factor restricting its potential luxuriousness. In some cases the fucoids can extend into the upper subtidal zone, but usually they are best developed in the mid-lower intertidal zones. A variety of annuals (e.g., *Petalonia fascia*, *Scytosiphon lomentaria*, *Dumontia incrassata* and *Enteromorpha linza*) can be mixed amongst the fucoids; their presence can vary significantly at different seasons.

The *Chondrus crispus* - annual red algae association also exhibits its maximum potential development when adequate substrate is available. It is present in the lower intertidal and upper subtidal zones. *Chondrus* is a perennial species, which reaches maximum size and abundance in the estuary. It is a major economic seaweed and is the basis for a multi-million dollar seaweed industry (Marine Colloids, Inc., Rockland, Maine). Chondrus provides a substratum for a variety of epiphytic forms such as Antithamnion plumula, Callithamnion sp., Ceramium rubrum, Ceramium strictum and Cystoclonium purpureum var. cirrhosum. Many red algae found in association with Chondrus are summer (e.g., Antithamnion plumla, Ceramium strictum, Lomentaria orcadensis and Polysiphonia harveyi) or winter-spring annuals (e.g., Dumontial incrassata). Even so, many other perennial forms, (Clathromorphum circumscriptum, Hildenbrandia prototypus, Polysiphonia elongata, Polysiphonia nigra, Polyides caprinus, Rhodymenia palmata, Laminaria spp. and Protoderma marinum) are present. As in the Ascophyllum-Fucus association, pronounced seasonal fluctuations are evident, particularly as compared to the deeper subtidal communities.

The Laminaria association is the most productive in both biomass and species composition, whenever substrate is not limiting. Laminaria saccharina usually dominates over L. digitata in the mid-lower subtidal zones, except when tidal rapids are present. Almost all of the red algae are evident in this association, except for Porphyra umbillicalis and Dumontia incrassata. The brown algae, Chorda filum, is rarely found amidst the kelps near the Schiller site. The green Algae, Chaetomorpha linum, Cladophora sericeae, Enteromporha linza and Monostroma fuscum may occur in localized quantities.

The Zostera marina association was most conspicuous at Stations 16, 34, and 44. Zostera is adapted to grow on muddy subtidal areas where relatively few other algal species can compete. In such areas it stabilizes muddy substrates, and a variety of algae (e. g., Polysiphonia harveyi, Antithamnion sp., Callithamnion spp., Ceramium spp., Petalonia fascia, Enteromorpha linza, Monostroma fuscum and Ulva lactuca) occur as epiphytes on its leaves and holdfasts. The Zostera association is a dominant and very important feature of New England estuaries.

3. THE ENVIRONMENTAL IMPACT OF THE PROPOSED ACTION

A. Beneficial Environmental Effects

With any major construction there will be attendant environmental effects, both beneficial and adverse. Two potential beneficial environmental effects associated with the Newington Station Unit No. 1 project are:

Fulfillment of the need for electrical power.

Permit unit load reduction of generating units that are less environmentally sound.

a. The need for electrical power in the area to be served by the Newington Station Unit No. 1 is as stated by the applicant a matter of statistically sound forecasting based on present power load and past rates of load growth. Beneficial application of this electrical power can be observed in such things as sewage treatment facilities, water purification equipment, cars and transit systems, general appliances, and heating systems which will require increasingly greater amounts of electric power.

b. The possibility of unit load reduction of less environmentally sound generating units presently in operation is reported to be contingent, in large part, on the operation of Newington Station Unit No. I. Several small steam-electric stations owned by Public Service of New Hampshire, although operating with complete regulatory agency sanction, are not equipped with modern pollution abatement systems such as electrostatic precipitators. Public Service Company has advised such outdated generating plants will have unit loads reduced when additional power such as that provided by Newington Station Unit No. I becomes available.

B. <u>Adverse Environmental Effects</u>

Environmental changes produced by the proposed 400 MW fossil fuel station may originate from the following construction and operational sources:

- Thermal addition to adjacent waters resulting from utilization of these waters as a cooling water medium.

- Dredge and fill required for installation of cooling water intake and discharge facilities.

- Entrainment and possible damage to planktonic and nektonic organisms by operation of the cooling water system.

- Biocidal action of residual chlorine added to circulating water system for control of fouling organisms.

- Detrimental independent and synergistic effects produced by other station chemical wastes; namely, phosphates, ammonia, dissolved solids and caustic solutions.

- Domestic sewage discharge from station.

- Stack emissions from oil fired boilers.

- Noise emissions.

- Land usage by construction of plant and associated facilities.

a. <u>Thermal addition</u>.

Heat addition to the Piscataqua estuary both for existing units at Schiller Station and for the proposed units is calculated on the basis of assumed full load continuous operation. The applicant reports that this would be a condition of infrequent occurrence.

The maximum heat load to the river from the 400 MW_e Newington unit is 2.2×10^9 Btu/hour at a maximum Δt of 20°F. This is calculated to raise the temperature of the tidal flow past Newington Station 0.082°F per tidal pass or 0.16°F for a complete cycle, conservatively assuming no dissipation of heat to atmosphere or stream bed. For the existing units at Schiller Station the heat load is 1.07×10^9 Btu/hour. This is calculated to raise the temperature of the tidal flow past the plant, after mixing, by 0.040°F/tidal pass or 0.079°F/tidal cycle assuming no heat dissipation. The total full load input from combined Newington-Schiller operation will raise the temperature of one tidal pass (6.2 hours) by 0.122°F. The ultimate temperature rise of the estuary for continuous operation is calculated as 0.67°F after heat loss to atmosphere. Therefore the time constant is $0.67/(0.122/6.2) =$ 34 hours for a step increase in heat input and will take four (4) time constants (4 X 34 hours = 136 hours or 5.7 days) to reach 98% of ultimate temperature rise. Thus the estuary, as defined by the applicant, will be raised 0.67°F. Specific values in the immediate vicinity of Newington Station, however, can be expected to be much greater and the ecological responses less easily predicted.

On a cumulative basis, for many tide cycles, the calculated maximum long-term peak temperature rise (outside the local mixing zone), assuming continuous full load operation of both stations, is given to be 0.94°F. The value is derived with consideration of the heat loss to the ocean from the flushing of the estuary and radiation and evaporation heat loss. If heat loss to the atmosphere by evaporation and radiation is not considered, then the calculated peak cumulative temperature rise due to oceanic dissipation alone, is 1.25°F. Since temperature calculations assume combined full load operation and consider no heat loss due to fresh water flow through the estuary, a highly variable factor, the values derived may be considered conservative on a monthly average basis.

An independently conducted study indicates the expected spatial extent of the mixing zone under various tidal conditions and the expected zone of passage. The zone of passage although seemingly within the guidelines of 50% of river cross section is near critical limits under slack tide conditions (Fig. 25A).

The Federal Water Quality Office standards for estuarial waters requires that the maximum temperature of the surface and bottom waters at the edge of the mixing zone shall not exceed the temperature of the surface and bottom waters, respectively, at the reference station by more than 1.5°F during the months of July, August, and September, or by more than 4°F during the remainder of the year. The temperature at no time shall be increased or decreased at a rate exceeding 1°F per hour. The measurements at the edge of the mixing zone and the measurements at the reference station shall be made simultaneously.

At the edge of the mixing zone the temperature of the water at any depth shall not exceed 82°F at any time. The temperature of the bottom waters at the edge of the mixing zone shall not exceed 77°F for more than an aggregate of 8 hours for any 24 hour period and shall not exceed 79°F at any time.

In addition, Piscataqua River waters are regulated by standards of water quality promulgated by the New England Interstate Water Pollution Control Commission (NEIWPCC). These standards agree essentially with those of the Federal Water Quality Office regarding maximum temperatures for estuarial waters.

NEIWPCC standards further provide that "at least 50% of the cross sectional area and/or volume of the flow of the estuary including a minimum of 1/3 of the surface as measured from water edge to water edge at any stage of tide, shall not be raised to more than 4°F over the temperature that existed before the addition of heat of artificial origin or a maximum of 83°F at the edge of the mixing zone, whichever is less." Figures 23 through 25A illustrate the proposed surface discharge for Newington Station Unit No. 1 based on 20°F Δt.

b. <u>Dredge and Fill</u>

In conjunction with the construction of Newington Station Unit No. 1, it is necessary to build a cooling water intake channel and discharge flume (Fig. 26).

An earth cofferdam will be used during construction and will be removed upon completion of the work. The presently planned cofferdamming scheme consists of constructing the cofferdam in two segments, one of 7000 cubic yards and another of 2000 cubic yards (it may be possible to utilize some of the same materials twice). These cofferdams will be high enough to avoid overlapping by storm tides (+12 MHW) and of a width sufficient to insure stability when dewatered, and to accomodate construction equipment (approximately 20ft. at the top and sloping downward into the water). The overall length of the cofferdams will approach approximately 1000 feet.

The total estimated quantity of material to be excavated is 23,500 cubic yards. A minimal amount of blasting will be required to excavate bedrock in the immediate construction area. Precautions will be taken and consideration given in its use so as to minimize any ecological disturbance. It may be possible to schedule the actual blasting operations during that period of the year (October-December) when migrating fish are least abundant.

Two land sites owned by Public Service Company are available for disposal of dredged materials unsuitable for reuse in construction. One is adjacent to the site and the second at Dover Point, New Hampshire, six miles away. The rock and sand and gravel to be dredged will be utilized in the project construction itself as fill and riprap. Alternate methods of disposal considered were the dumping of unusable dredged material on public dumping grounds, or in fill areas owned by others. Both of these methods, however, proved economically unfeasible.

Dredging and associated activities will result in the alteration of approximately three acres of intertidal and subtidal habitat. Temporary and local increases in turbidity and siltation may be expected during actual operations. Direct destruction and redistribution of any benthic plant and animal forms in the immediate area constitute another unavoidable consequence. The intake and discharge channel system will alter the shoreline and subsequent tidal current patterns, but the significance of this alteration upon local estuarine biota cannot be predicted at this time.

c. <u>Entrainment and Entrapment</u>.

Entrainment and entrapment of planktonic, and nektonic organisms will result from operation of the circulating water system. The circulating water flow is approximately 226,000 GPM.

Once entrained, organisms will be subject to a temperature increase as the water passes through the condenser. Maximum elevations of temperature over ambient will be 20°F. This differential temperature was selected after

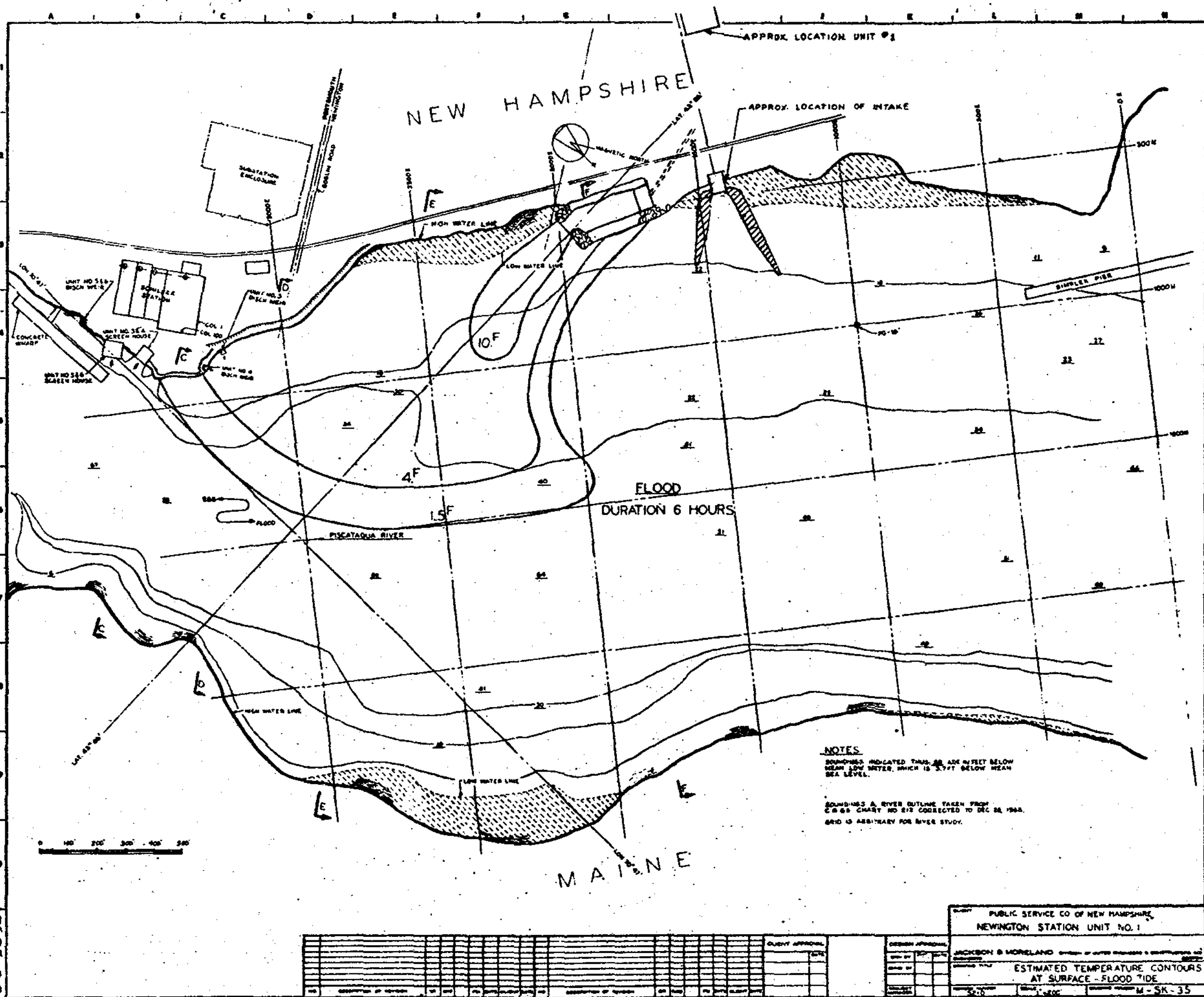

APPROX. LOCATION UNIT #1
NEW HAMPSHIRE
APPROX. LOCATION OF INTAKE
SUBSTATION ENCLOSURE
HIGH WATER LINE
LOW WATER LINE
SIMPLEX PIER
CONCRETE WHARF
10°F
4°F
1.5°F
FLOOD
DURATION 6 HOURS
PISCATAQUA RIVER
NOTES
MAINE
PUBLIC SERVICE CO OF NEW HAMPSHIRE
NEWINGTON STATION UNIT NO. 1
JACKSON & MORELAND
ESTIMATED TEMPERATURE CONTOURS
AT SURFACE - FLOOD TIDE
M-SK-35

FIG. 23

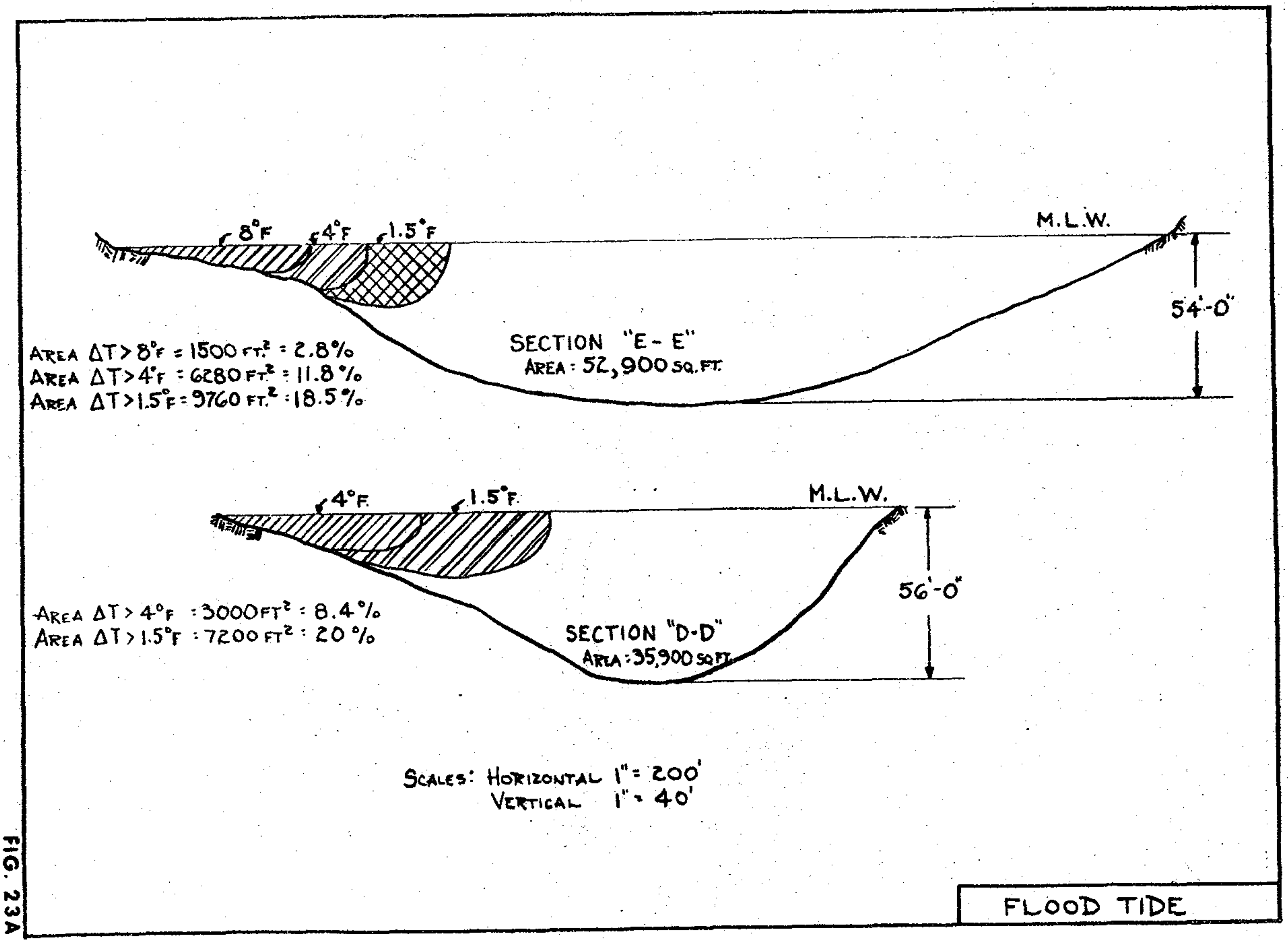
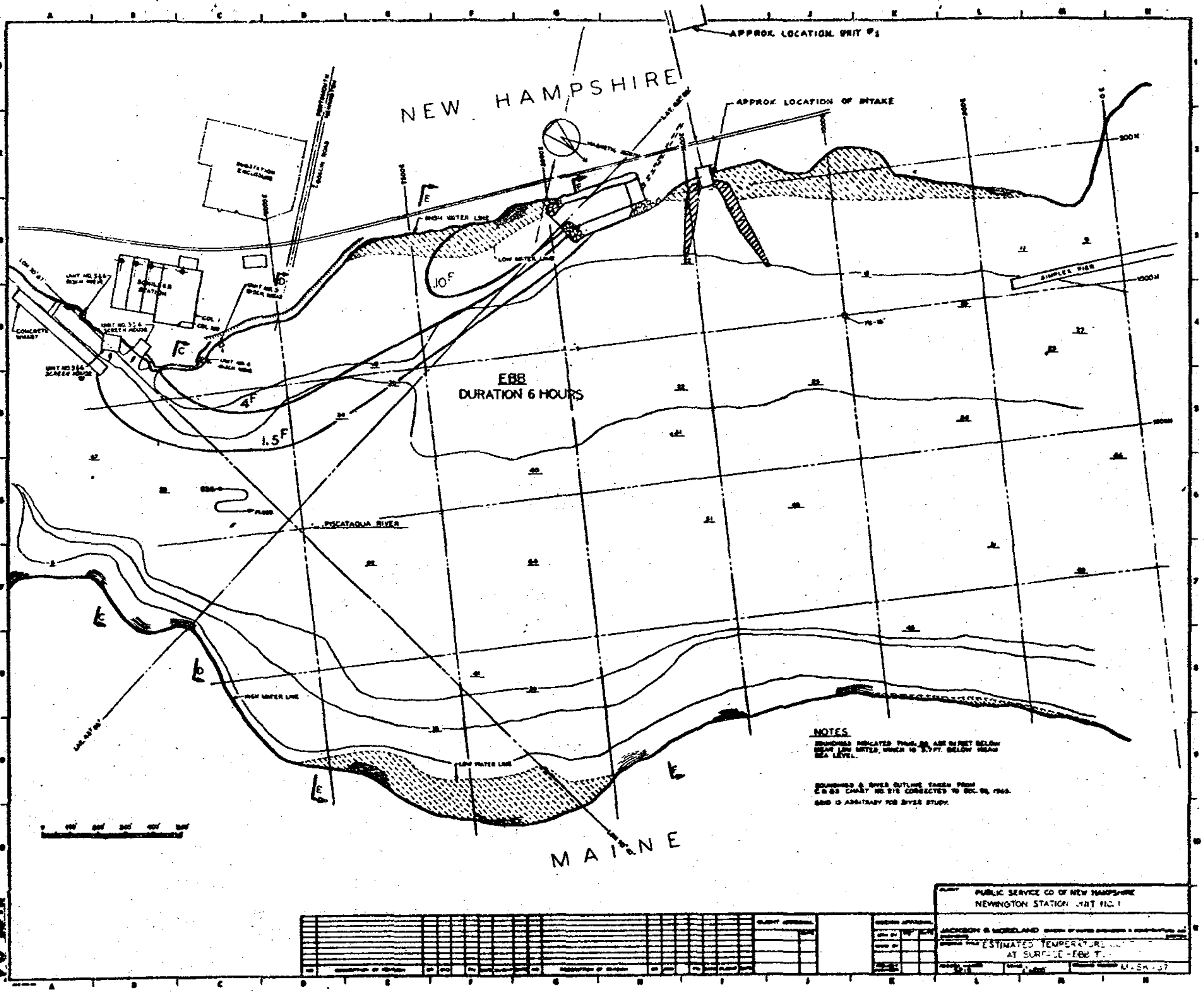

8°F
4°F
1.5°F
M.L.W.
54'-0"
SECTION "E - E"
AREA : 52,900 SQ. FT.
AREA ΔT > 8°F = 1500 FT.² = 2.8%
AREA ΔT > 4°F = 6280 FT.² = 11.8%
AREA ΔT > 1.5°F = 9760 FT.² = 18.5%
4°F.
1.5°F.
M.L.W.
56'-0"
SECTION "D-D"
AREA : 35,900 SQ. FT.
AREA ΔT > 4°F : 3000 FT² : 8.4%
AREA ΔT > 1.5°F : 7200 FT² : 20%
SCALES: HORIZONTAL 1" = 200'
VERTICAL 1" = 40'
FLOOD TIDE

FIG. 23A

56c



APPROX. LOCATION UNIT #1
NEW HAMPSHIRE
APPROX. LOCATION OF INTAKE
HIGH WATER LINE
LOW WATER LINE
10F
4F
1.5F
EBB
DURATION 6 HOURS
PISCATAQUA RIVER
SIMPLEX PIER
CONCRETE WHARF
MAINE
NOTES
PUBLIC SERVICE CO OF NEW HAMPSHIRE
NEWINGTON STATION UNIT NO. 1
JACKSON & MORELAND
ESTIMATED TEMPERATURE
AT SURFACE - EBB T.

FIG. 24

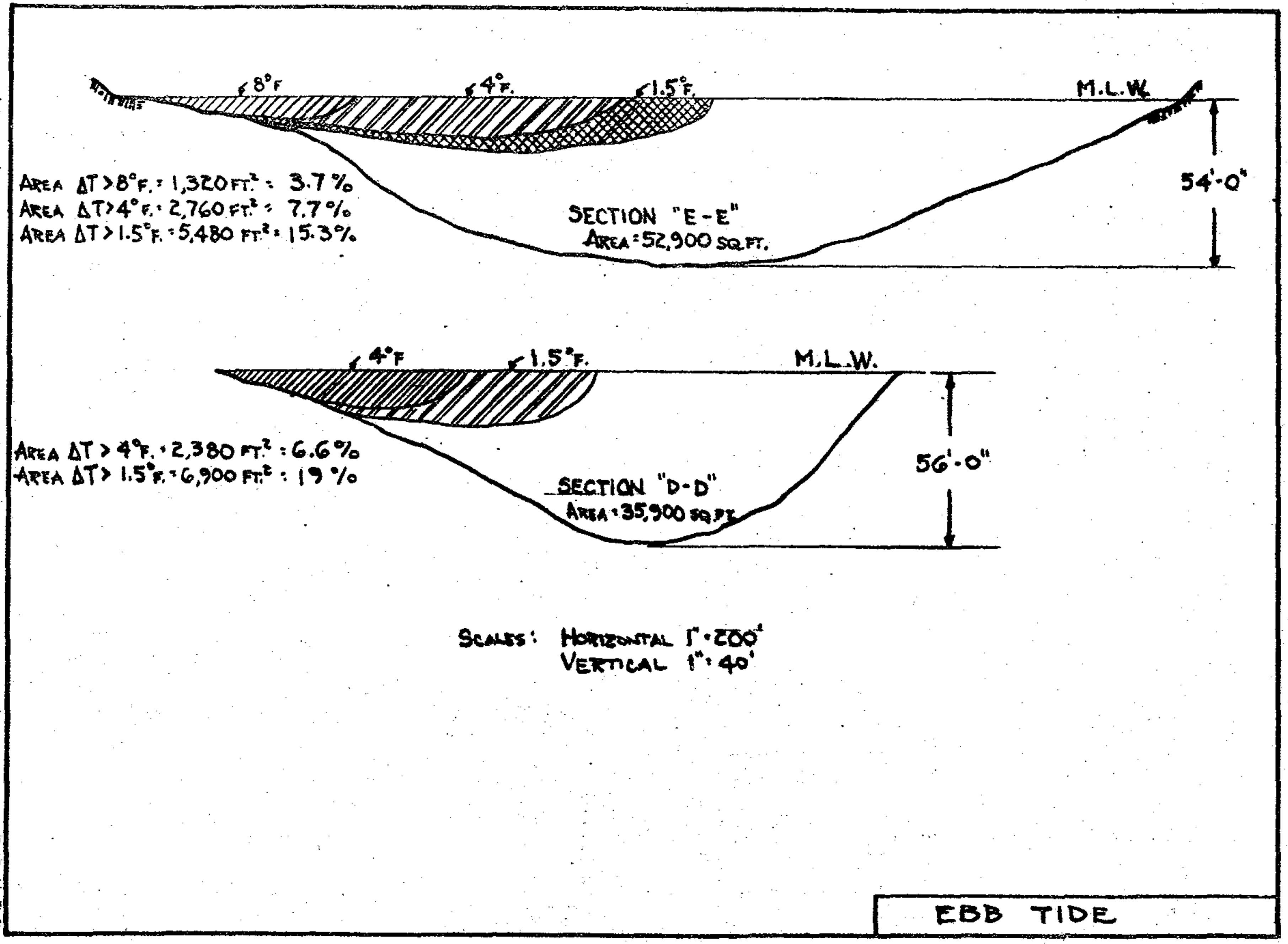
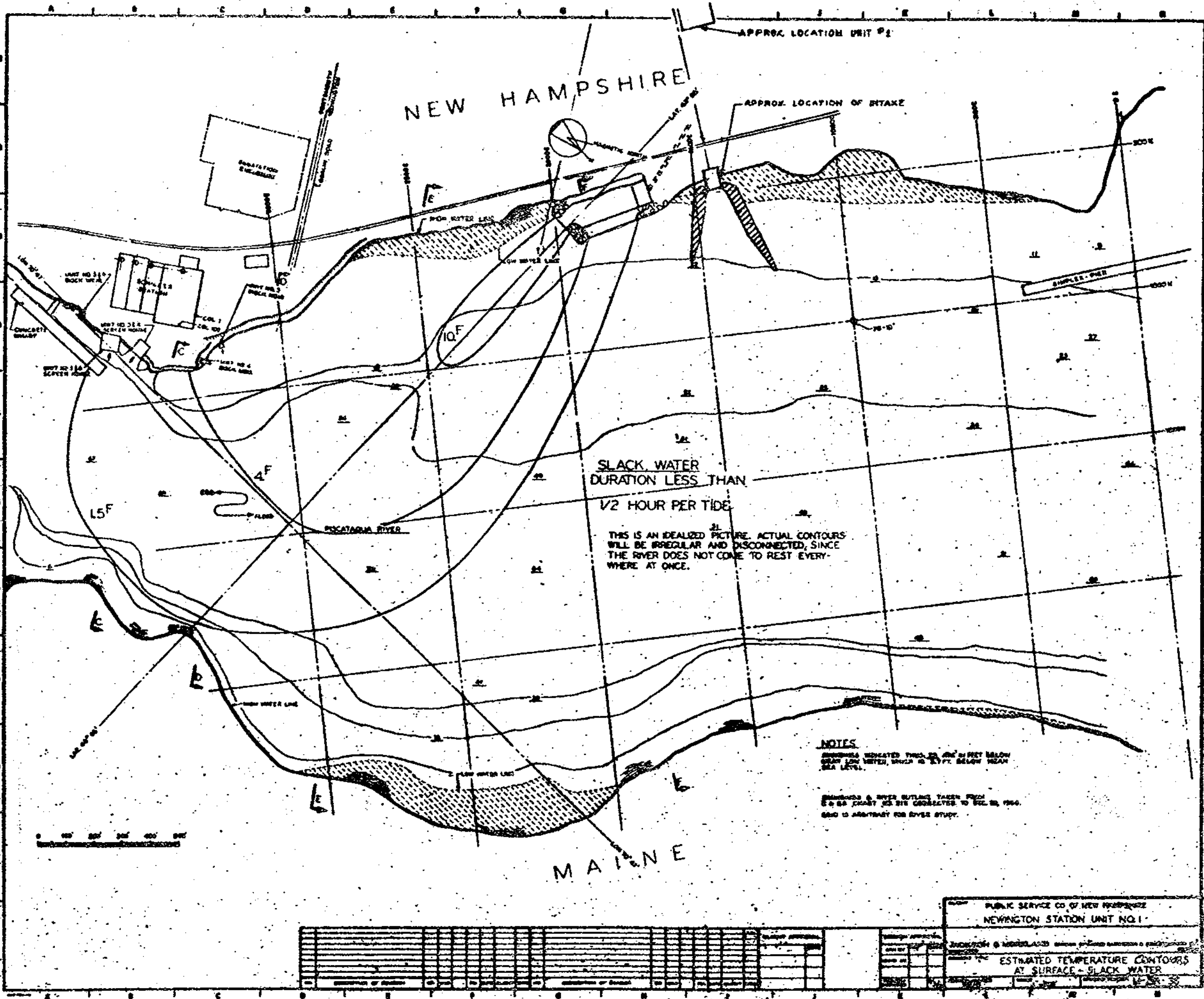

8°F
4°F.
1.5°F.
M.L.W.
54'-0"
AREA ΔT > 8°F. = 1,320 FT.² = 3.7 %
AREA ΔT > 4°F. = 2,760 FT.² = 7.7 %
AREA ΔT > 1.5°F. = 5,480 FT.² = 15.3 %
SECTION "E - E"
AREA = 52,900 SQ.FT.
4°F
1.5°F.
M.L.W.
56'-0"
AREA ΔT > 4°F. = 2,380 FT.² = 6.6 %
AREA ΔT > 1.5°F. = 6,900 FT.² = 19 %
SECTION "D-D"
AREA = 35,900 SQ.FT.
SCALES: HORIZONTAL 1" = 200'
VERTICAL 1" = 40'
EBB TIDE

FIG. 24A



APPROX. LOCATION UNIT #2
NEW HAMPSHIRE
APPROX. LOCATION OF INTAKE
SIMPLEX PIER
10°F
4°F
1.5°F
PISCATAQUA RIVER
SLACK WATER
DURATION LESS THAN
1/2 HOUR PER TIDE
THIS IS AN IDEALIZED PICTURE. ACTUAL CONTOURS WILL BE IRREGULAR AND DISCONNECTED, SINCE THE RIVER DOES NOT COME TO REST EVERYWHERE AT ONCE.
NOTES
MAINE
PUBLIC SERVICE CO OF NEW HAMPSHIRE
NEWINGTON STATION UNIT NO. 1
ESTIMATED TEMPERATURE CONTOURS
AT SURFACE - SLACK WATER

FIG. 25

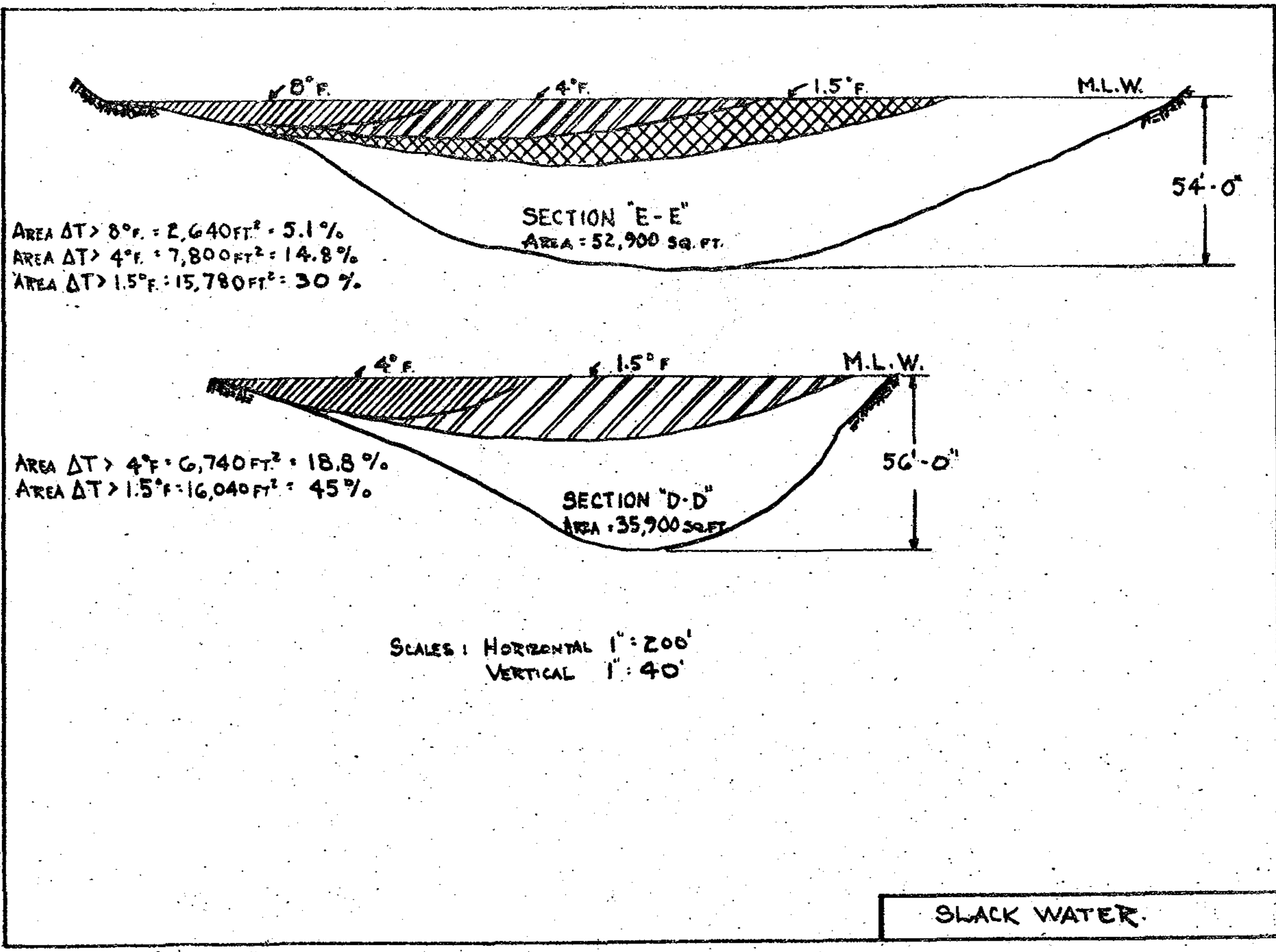
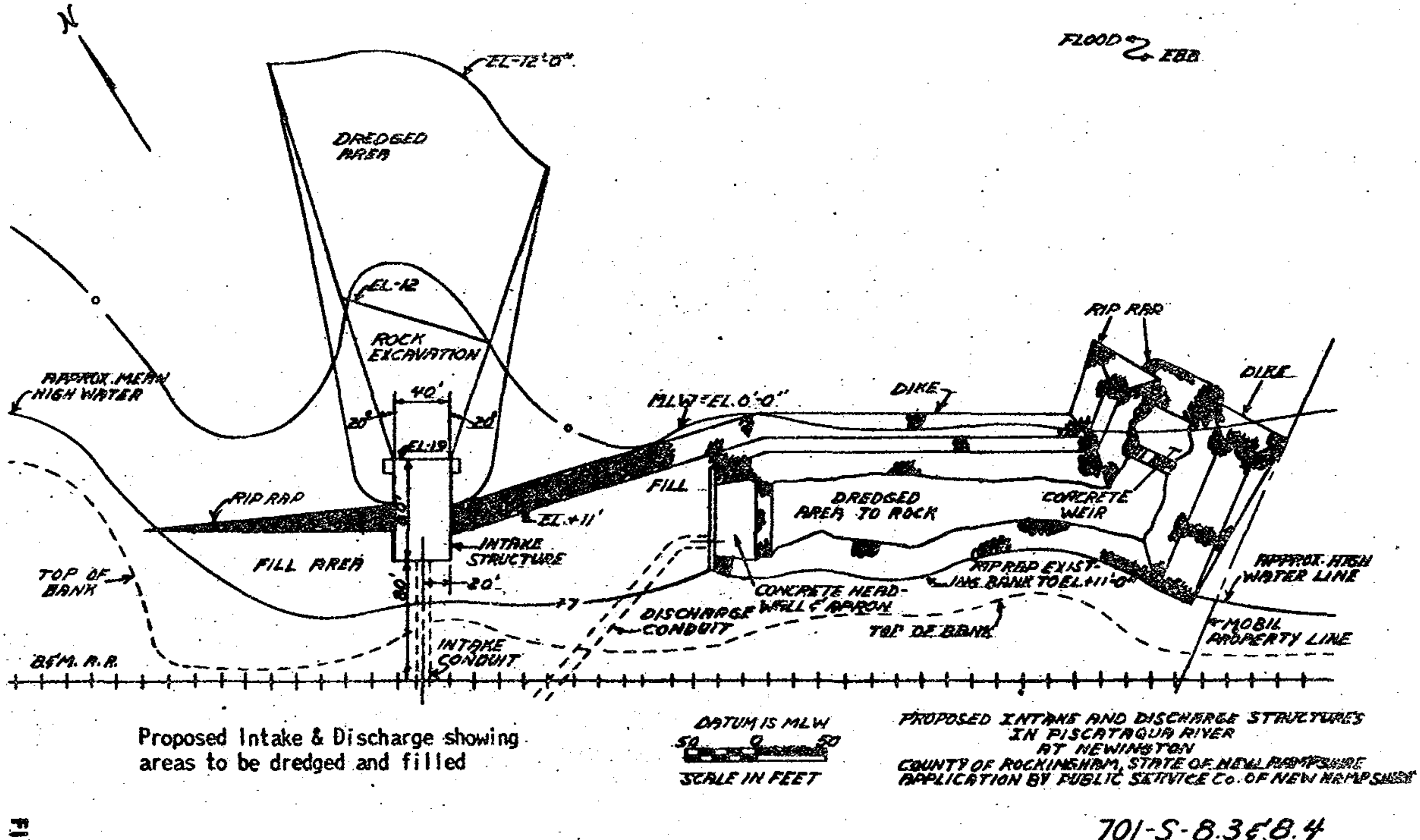

8°F.
4°F.
1.5°F.
M.L.W.
54'-0"
SECTION "E-E"
AREA = 52,900 SQ. FT.
AREA ΔT > 8°F. = 2,640 FT.² = 5.1%
AREA ΔT > 4°F. = 7,800 FT² = 14.8%
AREA ΔT > 1.5°F. = 15,780 FT² = 30%
4°F.
1.5°F
M.L.W.
56'-0"
AREA ΔT > 4°F = 6,740 FT.² = 18.8%
AREA ΔT > 1.5°F = 16,040 FT² = 45%
SECTION "D-D"
AREA = 35,900 SQ. FT.
SCALES: HORIZONTAL 1" : 200'
VERTICAL 1" : 40'
SLACK WATER.

FIG. 25A



Proposed Intake & Discharge showing areas to be dredged and filled

FIG. 26

consultation with Normandeau Associates, Inc. (the applicant's bioenvironmental consultant) and a review of the operating experience at Schiller Station which has a 20oF rise.

In addition to thermal shock, entrained organisms will be subjected to other stresses. Potential physical damage from passage through the circulating water pumps and condenser tubes, injection of controlled amounts of sodium hypochlorite into the circulating water for control of bio-fouling, pressure gradients, and synergestic action of all these factors could result in destruction and damage of nektonic and planktonic organisms including fish eggs and larvae.

A study of the effects of entrainment on planktonic forms is currently in progress utilizing the once-through condenser cooling system at Schiller Station Unit No. 4. This program was initiated on October 4, 1971 in an effort to gain entrainment effects information and is presently being conducted by Public Service Company of New Hampshire personnel. The data derived will hopefully be useful for future comparison and evaluation of any combined effects imposed by dual station operations.

The objectives of this study are as follows:

1. Identification of the types of planktonic organisms entrained, their relative densities and natural density fluctuations throughout the year.

2. Comparison of distinct planktonic organisms before and after their entrainment and passage through the condenser cooling system. This comparison is based on both observable behavioral characteristics and gross physical appearance.

3. Assessment of damage attributable to various entrainment factors such as thermal shock, physical damage by pumps, and injection of antifouling chemicals. This appraisal is done by varying collections to cover all combinations of heat load and chlorine concentrations.

The basic method of investigation involves the periodic (weekly) sampling of planktonic forms at both intake point and discharge of Schiller Station Unit No. 4. During collections of samples additional information regarding tidal state, unit heat load and chlorination schedule is recorded, thus providing information for future correlation of these factors with other study data. This collection is accomplished by the pumping of intake and discharge waters through a No. 20 mesh plankton net for approximately five minutes thus providing nearly equal sample volumes. Replicate samples are taken in a similar manner. Immediately after collection, these samples are placed in a shallow counting dish which allows identification, observation and enumeration of collected plankters. To facilitate evaluation, plankters are grouped into the following broad groups:

Copepods

Nauplii Larvae

Post Trochophore Annelids

Gastropod Veligers

Bivalve Veligers

It should be noted that this grouping is not immutable and should future considerations or findings warrant splitting of these groups or addition of other groups, it could be done.

Following initial examination, the dishes containing plankton are stored in a refrigerator, being removed at two hour intervals for additional observation. This method is thought to best approximate actual conditions experienced by planktonic organisms after their entrainment. Sequential examinations continue for at least six hours. After complete examinations the samples are preserved for future reference.

Preliminary analysis by the applicant of the fourteen (14) weekly samples to date indicate no qualitative differences between intake and discharge samples.

Quantitative differences may exist and with a standardized sampling technique and statistical analysis these might become apparent. Statistical analysis will involve a split plot analysis of variance and "F" test for significance.

This program is proceeding on a sampling schedule of one per week. An evaluation of the effect of entrainment on planktonic forms should not be expected until at least one year of data has been accumulated.

Public Service Company of New Hampshire has informed the Corps that study programs concerning plankton and fish eggs and larvae have been or will be increased commencing this year. The acceleration of this portion of the monitoring program was precipitated by the earlier Corps criticisms contained in the draft and by a meeting in the latter part of May between the applicant, Corps, and New Hampshire Department of Fish and Game, during which shortcomings of the monitoring program were emphasized and recommendations for expansion discussed.

As a result of species composition and diversity zooplankton and phyto-plankton communities are now being monitored in the immediate area of the proposed intake/discharge area on a monthly basis with replicate samples at the surface and 8 meter depths on both ebb and flood tides. Fish eggs and larvae will also be sampled on a bi-weekly basis using coarse meter nets.

A study in plankton entrainment and effects of circulating water system at Newington Station will become effective upon start-up of the facility. The study will follow an accepted statistical experimental design and evaluate immediate as well as delayed mortality.

In view of the hazards of entrainment for nektonic and pelagic organisms certain features in intake design have been provided. The proposed intake velocity will reportedly be limited to a range of .68 to less than 1.0 fps throughout the mean tide range allowing some of these forms, including fish, to resist entrainment. This agrees fairly closely with the Bureau of Sport Fisheries and Wildlife policy that water approach velocity at the traveling screens be limited to between 0.50 to 0.75 fps. Physical obstruction of entrance into the system is accomplished by a coarse bar rack with spacing of 3-5/8" between adjacent bars and a vertical traveling water screen with 3/8" square mesh screen. The rack will hopefully deter large fish such as adult striped bass and coho salmon from entering the intake system. It will not inhibit the entrance of juvenile fish however. Smaller nektonic forms which pass readily through the outer coarse bar rack may be filtered from intake water by the vertical traveling screen. The 3/8" square mesh screen will allow passage of fish larvae and eggs and plankters through the condensers thereby subjecting them to the prevailing conditions (e.g. heat, chemicals and turbulence and mechanical forces) characterizing the cooling system. If caught by the screen, they will periodically be lifted from the water, removed by a screen wash system and returned to the estuary. A similar system has been in effect at Schiller Station without encountering significant problems of fish uptake. However, in the case of Newington Station the present design plan for the sluice troughs coupled with the local current pattern renders planktonic life forms susceptible to reintake or distribution into the discharge flume.

These systems of intake straining and occlusion will be effective only for nektonic animals. Plankton will easily pass through such systems and be returned to the estuary.

To gain information on the potential for Newington Station intake and traveling screen fish entrapment, a study program was instituted at the presently operating Schiller Station. It was felt that information gained at this existing facility might provide a basis for assessment of this potential fish entrapment to the Newington operation. Although gross similarities exist between the intake design of Schiller Station and that planned for Newington, the effort expended in reducing potential entrapment features in the Newington Station can only render conservative predictions. The physical location of the two plants with respect to shoreline configuration and current regime precludes extrapolation of data with any high degree of certainty.

Public Service Company reports that the Schiller Station Unit No. 4 screen caught the most material. This is possibly explained by Unit No. 4 being served by a single screen, whereas the other three units have intakes with two screens. Using the Unit No. 4 screen for the study would, therefore, provide a "worst possible case" evaluation. Other screens are reportedly used only during a breakdown period on No. 4 screen.

The present method of study is basically simple. The water containing the material washed from the traveling screens leaves the unit via a trash trench and is conducted back to the river. To collect this rejected material a rectangular screen was constructed which could be fixed in place within the trash trench. This collecting device was constructed of galvanized band iron and screen of the same size mesh as that of the traveling screen (3/8 inch mesh). Once weekly during the routine wash procedure (generally every four hours) this collecting screen was set in the trash trench in such a way that it would catch all the material before discharge back into the river. This material was subsequently placed into plastic buckets for transport and later closely examined to characterize its floral and faunal complement. Examination is initially accomplished with the naked eye. If needed, a dissecting microscope (7x - 30x magnification) was used for inspection of detail. Determination of general condition was based on completeness of form and display of typical behavioral patterns. Entrapped fish per hour figures and survival rates were calculated.

The results of the thirty-five (35) samples collected on thirty-three (33) separate dates relative to fish entrapped are shown in Table XVI.

Thus far twenty six (26) adult fish have been collected in thirty-five (35) samples. Of these, eight have been alive when taken and the remainder (18) dead. Only one of the dead fish showed obvious signs of physical damage believed caused by the mechanical action of the traveling screen. The other dead fish were externally undamaged. In these cases death may be attributed to one of several possibilities. These include: suffocation by prolonged impingement upon the intake screen, or some unknown cause not associated with power plant operation. In the latter possibility it is assumed that the fish are dead or dying when they are swept into the screen.

TABLE XVI - ENTRAPPED FISH COLLECTED ON SCHILLER STATION INTAKE SCREENS

Date of Collection	Unit No.	Wash Frequency (Hours)	Total Sample Volume (gallons)	Adult Fish	Juvenile Fish	Condition
Feb. 26	4	4	2	1 grubby	0	live
Mar. 4	4	4	1½	0	0	
11	4	4	1	0	0	
17	4	4	3/4	0	0	
24	4	4	1¼	1 grubby	0	live
31	4	4	2	0	1 clupeid	dead
Apr. 9	4	4	2	0	0	
15	4	1	1	0	0	
21	4	5	2	2 grubby 1 pipefish	3 clupeids (?)	adults live larvae dead
29	4	4	2	0	0	
May 6	4	1	3/4	1 lumpfish	0	live
11	4	4	1/2	0	0	
21	4	4	2	1 grubby	0	live
28	3	4	2	0	0	
June 3	4	4	1/2	1 pollack	0	dead
11	4	4	2	1 grubby	0	live
18	4	3	1	2 grubby 2 cunner	0	dead
23	*3+4	4	2	0	0	
July 1	3+4	2	1½	0	0	
9	3+4	2	2	0	0	
16	3+4	2	1	1 flounder	0	dead
22	3+4	2	6	1 tomcod	0	dead
29	3+4	2	1½	0	0	
Aug. 5	3+4	2	1½	2 cunner 2 flounder 1 shorthorn sculpin	0	dead dead
13	3+4	2	3	1 flounder 1 cunner	0	dead
18	3+4	2	3	0	0	
26	3	2	2	0	0	
Sept. 2	**3	3	1-1	0	0	
9	*3	4	3-3	0	0	
16	4	4	2	1 grubby	0	dead
24	4	4	2	0	0	
29	4	4	2	1 tomcod	0	dead
Oct. 6	4	4	6	1 tomcod 1 mummichog	0	dead dead

*due to a breakdown on Unit #4 screen the Unit #3 screen served as intake for both Units 3 and 4 from June 23 to August 18.

**on September 2 and 9 samples were taken from both Unit #3 screens.

Juvenile fish were collected only twice and were all dead when taken. Of interest, also, is the collection of three clusters of fish eggs believed to be those of the rock eel (Pholis gunnelus). The egg masses were taken on February 26, March 24, and March 31. Inspection of these eggs revealed viable embryos.

A total entrapped adult fish per hour figure was calculated at .23/hour with a 31% survival rate. This amounts to roughly five adult fish per day, two of which survive. Juvenile fish were caught at a rate of .03 fish/hour with none surviving, the statistical soundness being questionable due to sample size.

Extrapolations of these data to the Newington Station operation are not considered advisable due to the operational differences in the two stations as well as physical location with respect to the river environment.

The condition of invertebrate animals, entrapped and subsequently washed into the trash trench, was generally excellent. Of the seventy (70) invertebrate species collected only two were judged to be seriously damaged by the traveling screen experience. These were a single ctenophore (Pleurobrachia pileus) collected on March 11, 1971, and nine jellyfish (Aurelia aurita) collected on May 21 and 28, 1971. These soft-bodied animals were badly lacerated where examined, which presumably resulted from their impingement on the traveling screen. The five Aurelia taken on May 28th were returned to the river when they all exhibited typical pulsating movements despite their lacerated condition.

On the basis of these observations, it is believed that the invertebrates typically caught on the traveling screens of Schiller Stations units survive this experience very well.

d. Biocidal Action of Residual Chlorine

The presence of sodium hypochlorite within the circulating water system discharge may adversely affect marine biota. Since the express purpose of the chlorine within the system is to inhibit or eliminate biofouling of intake lines as a functional necessity, it is obvious that chemical detriment is effectuated on entrained organisms. Responses of marine organisms to short term, low level doses of chlorine is highly variable. The degree of adversity will depend primarily on the level of chlorine, temperature, and exposure time.

The Public Service Company of New Hampshire has received approval from the State of New Hampshire Water Supply and Pollution Control Commission for the discharge of 0.3 ppm maximum chlorine residual in its circulating water effluent. The exact chlorination schedule for Newington Station Unit No. 1 is yet to be determined and precise intake and discharge concentration levels and dosing periods will depend largely on early operation experience.

Some inference of the finalized chlorination schedule for Newington Station may be gained from Schiller Station Unit No. 4 experience. This particular unit has recently undergone a "continuous" low level chlorine dosing evaluation. During this period, sodium hypochlorite was added at the intake in volumes which resulted in a concentration level of 0.2 ppm chlorine and was found to be at a concentration of less than 0.1 ppm at the discharge.

The term "continuous" is misleading as the dosing actually occurred eight hours per day five days a week and only when the river water temperature was above 45°F (April to November). It is conceivable that a dosing schedule similar to that described for Schiller Station Unit No. 4 will be used also for Newington Station.

During preliminary coordination phases of this project, the Environmental Protection Agency reported that "recent investigations showed that chlorine residuals at 0.3 ppm levels may produce adverse effects upon the biota in the receiving waters. Operating experience at the Cape Cod Canal Fossil Fuel Station demonstrated that a maximum residual concentration of 0.1 ppm in the discharge had no adverse effects on fishery resources while fouling growth within the plant's cooling water system was inhibited." A study by the University of Minnesota reports that chlorine doses lasting one hour four times daily, coincided with growth and respiration problems experienced by the phytoplankton. Results of a comprehensive study on effects of various chlorine concentrations at the Millstone Point, Connecticut nuclear power station, illustrated that concentrations considerably below those required to eliminate fouling organisms produced large decreases in productivity of entrained phytoplankton (Carpenter et al, 1972). At the highest chlorine concentration applied, 0.4 ppm residual at discharge (addition of 1.2 ppm at intake), there was an 83% decrease in productivity. At the lowest concentration tested, to low to measure with standard analytical methods, (0.1 ppm chlorine addition at intake) a production decrease of 79% was measured. Some macrofouling forms such as the colonial hydroid <u>Bimeria frustrana</u> has shown evidence of growth even when exposed to concentrations of 4.5 ppm chlorine for one and three hour periods. However, a decrease in percentage of new growth did occur in those colonies exposed to 2.5, 3.5 and 4.5 ppm concentrations (McLean, 1972). While the results indicate that intermittent dosage of chlorine may not be an effective growth control method for this particular fouling species it does not imply that continuous exposure nor exposure for periods greater than three hours at similar concentration will not produce mortality. In fact biofouling toxicants by design are known to induce long term terminal stress on attachment organisms. On the basis of this information, EPA is recommending that the maximum concentration of chemical biocides not exceed 0.1 ppm at point of discharge. The use of chlorine shall be restricted to not more than 10 hours a week.

e. Other Station Wastes

These may pose some impact on the environment through independent and/or synergistic effects and these have been studied and evaluated by the applicant. The purpose of the study was to enumerate and classify each type of station waste associated with plant operation and to propose an overall scheme of waste disposal which is environmentally sound and is consistent with water quality standards. Since the exact chemical-mechanical processes associated with operation of the station have not been completely determined, it is impossible, however, to predict the exact character and volume of all waste discharges. It is possible, however, to approximate the quantity and quality of wastes present together with the period of occurrence of most discharges and from this to develop a conceptual plan of an overall treatment system. Because of the somewhat indefinite character of the wastes, a margin of flexibility has been incorporated into this system so that future contingencies may later be accommodated for.

The general design concept of Newington Station plant waste handling is to provide a system which will route, detain and routinely monitor generated liquid wastes so as to assure an effluent which is both acceptable to regulatory agency water quality criteria and consistent with preservation of river biota. All station waste products will, after undergoing such treatment as necessary to assure conformance with prescribed concentration levels, be discharged via a common outlet pipe into the circulating water system effluent. Public Service Co. emphasized that concentration level criteria will be met and demonstrated before issue of common waste liquid into the circulating water system.

Below is a list of known station waste products and the proposed effluent standards which will be met:

Station Waste	Proposed Effluent Standards
Oil	none visible
chlorides (as Cl)	15,000 ppm (1)
phosphate (as P)	5.0 ppm
ammonia (as N)	0.5 ppm
chromate (as hex, Cr)	0.05 ppm

Station Waste (cont.)	Proposed Effluent Standards (cont.)
sulfate	2,000 ppm (1)
zinc	0.5 ppm
total dissolved solids	30,000 ppm
total suspended solids	30 ppm
pH	6.5 - 8.0 (2)

(1) Concentration levels known to occur as Piscataqua River background.

(2) Effluent criteria as presently established by the State of New Hampshire.

Tabulated below are specific routine waste producing procedures, the types generated, and the methods used for treatment prior to discharge.

1. Drains potentially oil contaminated

The drains located around the mechanical equipment will have a tendency to pick up oil during normal operational maintenance procedures. These drains will be routed to a gravity type oil separator complex for treatment as required.

2. Demineralizer waste:

The waste produced by the demineralization of water from the Portsmouth Water Department's system will consist of spent acid, caustic and dissolved solids. These waters will be routed to a holding tank and detained where they will be largely self-neutralizing. Further neutralizing on an as required basis will take place here,followed by discharge to large holding/settling basins.

3. <u>Boiler blowdown effluent:</u>

The type and quality of contaminants in blowdown effluent depends on the composition of make-up water. In a high pressure boiler of the type proposed for Newington Station, the blowdown volume would be relatively small and contains quantities of ammonia, phosphates and dissolved solids. Detention of blowdown effluent and treatment as required will assure compliance with proposed standards.

4. <u>Laboratory waste</u>:

The quality and quantity of waste generated in a small laboratory operation will vary considerably from day to day but in any case the quantity is reputed as being minor. The waste will contain apnreciable amounts of dissolved solids (reagent chemicals) as well as acids and trace metals. These wastes will be neutralized as necessary before release to the holding/settling basins to assure compliance with proposed standards.

5. <u>Miscellaneous floor drains</u>:

All floor drains in the power plant were considered potential carriers of undesirable substances. Therefore, even though they may not be located near specific waste sources, some provision was made for such possibilities. Newington Station floor drains will be routed in the same manner as equipment drains for treatment and monitoring in the oil separator complex.

In addition to the above described routine waste producing procedures, there are certain periodic waste sources which have received consideration. These sources and the manner in which they will be handled are as follows:

a.) Boiler cleaning operation - During periodic cleaning operations several volumes of boiler wash water will be generated. Each separate wash cycle will produce waste water contaminated with acids, caustic, dissolved and suspended iron compounds. These boiler wash waters will be detained and treated as required to assure compliance with proposed standards within the holding/settling basins provided.

b.) Fly ash collection - Accompanying the periodic collection of fly ash from both furnace bottom and electrostatic precipitator will be a rinsing procedure. This process will generate waste water which is oily and of low pH and will be routed for separation, neutralization and settling prior to release.

c.) Stack wash down - This periodic procedure will generate waste water of much the same character as that produced in the rinse accompanying the collection of fly ash. Therefore, routing, detention and treatment will be approximately the same.

Oil spills from switchyard transformers and fuel storage tanks are not a predictable occurrence but nevertheless must be considered. In view of this potential, all areas of large volume oil storage will be either placed over a holding sump or enclosed behind adequate dikes. This system assures that an emergency rupture and loss of oil will be totally contained until clean up thus allowing an effective waste control.

The treatment system is being designed so as to offer a high degree of flexibility of operation. The design intent stresses the ability to isolate, detain, monitor and treat accordingly all routine and periodic wastes and further, to provide safeguards to preclude accidental release of stored oil.

A review of relevant water quality criteria and established standards provides substantiating evidence that the waste concentration levels proposed by the applicant for Newington Station Unit No. 1 are within reasonable bounds. These station wastes have received approval by the New Hampshire Water Supply and Pollution Control Commission at the concentration levels proposed.

The possibility of the addition of toxic chemicals to the environment due to normal operation of a condenser cooling system such as that planned for Newington Station Unit No. 1 has generated some concern. This concern centers around the question of the possibility of circulating water system hardware degradation which might release such metals as copper, iron, chromium, zinc, etc. into the river. To evaluate this potential a program of water analysis has been under way since February 1971. Schiller Station Unit No. 6 is the study model, selected on the basis of similarity in design to that proposed for Newington. The program involves the wet chemical and spectrographic analysis of water samples taken at intake and discharge points once a month. These water samples have been composites of four (4) separate grabs taken at six (6) hour intervals over a twenty-four (24) hour period. The timing of grab samples has been such that water adjacent to the intake sample is collected from the discharge weir after its two minute and twenty second period of passage through the system. Consistent differences in chemical characteristics between intake and discharge samples may be interpreted as circulating water system additions or deletions.

The results of seven (7) monthly samples (February through August 1971) support several tentative conclusions.

1. Sodium is added to the sea water as it passes through the circulating water system.

2. Iron and silica are usually added to the sea water as it passes through the circulating water system.

3. Calcium, magnesium, silicon, boron, aluminum, potassium, nitrate, and phosphate usually show reduced levels as sea water passes through the circulating water system.

4. The remaining chemicals and physical parameters tested show no consistent results.

A tabulation of relative effect upon concentration levels of various water constituents, resulting from passage through the circulating water system is shown in Table XVII.

Specific concentration values for those chemicals showing change for the seven (7) months sampled are shown in Table XVIII.

Predictions of Newington Station Unit No. 1 water chemistry perturbations based on known Schiller Station data are possible but should be viewed with cognizance of system hardware differences. Various system parts of both the Schiller study model (Unit No. 6) and the planned Newington system are tabulated below and their composition noted:

Part	Newington Composition	Schiller Unit No. 6 Composition
1. Inlet Bell	Ni Resist	Stainless Steel
2. Pump Column	2% Nickel Cast Iron	2% Nickel Cast Iron
3. Pump Impeller	Stainless Steel	Stainless Steel
4. Pump Shaft	Monel	Monel
5. Pump Head & Elbow	2% Nickel Cast Iron	Cast Iron
6. Pump Discharge Piping	Neoprene Lined Steel	Cast Iron
7. Condenser Intake Tunnel	Concrete	Concrete
8. Condenser Water Boxes	Neoprene Lined Steel	Zinc Painted Cast Iron
9. Condenser Tubes	90-10% Copper-Nickel	Aluminum-Brass
10. Outfall Tunnel	Concrete	Concrete

Since an addition of metals to sea water caused by system hardware degradation represents parts destruction every effort is made to assure its reduction. The design of Newington Station Unit No. 1 should, because of technological advances in the area of metallurgy (specifically corrosion prevention), produce a circulating water system less subject to parts degradation.

f. Domestic Sewage

Sewage from the station toilets and lavatories must be considered a potential impact on the environment. Quantities of sewage are anticipated from two sources:

TABLE XVII

Effect of Passage Through Circulating Water System Upon Various Water Constituents

		Feb.	March	April	May	June	July	August
Spectrographic Analysis	Sodium	+	+	+	+	+	+	+
	Calcium	-	-	+	-	-	-	+
	Magnesium	-	+	-	-	-	-	-
	Silicon	-	-	-	+	-	-	+
	Boron	-	-	+	-	-	-	-
	Iron	+	-	o	+	-	+	+
	Aluminum	-	+	+	-	-	x	-
	Copper	+	-	-	+	+	-	+
	Silver	-	x	x	x	x	+	x
	Potassium	-	+	-	-	-	+	-
	Strontium	+	+	-	-	-	-	+
	Vanadium	x	o	x	x	x	x	+
	Chromium	x	x	x	+	x	x	-
Wet Chemical	Chloride	+	-	+	-	-	+	-
	Sulphate	+	-	+	-	-	+	-
	Nitrate	-	-	o	-	-	-	+
	Phosphate	-	o	-	-	-	+	+
	Bicarbonate	+	+	+	-	-	+	-
	Silica	+	+	+	+	o	o	+
	Iron	-	-	+	+	+	+	+
	Total Residue	+	-	+	-	-	+	-
	Suspended Matter	-	+	o	o	o	o	+
	Total Hardness	+	-	+	-	-	+	-
	Alkalinity	+	+	+	-	-	+	-
	pH	+	+	+	-	-	+	-

\+ increase in concentration level through plant
\- decrease in concentration level through plant
o no difference in concentration level through plant
x none present in either intake or discharge sample

TABLE XVIII

Specific Concentration Values for those Chemicals Showing Change

	Expressed in	February int.	February dis.	March int.	March dis.	April int.	April dis.	May int.	May dis.	June int.	June dis.	July int.	July dis.	August int.	August dis.
Sodium	%(1) total residue	33	35	29	30	25	30	32	33	28	32	30	32	32	36
Iron	ppm(2)	.12	.11	.12	.10	.08	.09	.08	.09	.09	.10	.09	.10	.09	.24
Silica	ppm	4.80	4.90	4.00	4.20	5.10	5.20	4.80	4.90	4.90	4.90	5.30	5.30	4.60	5.10
Calcium	% total residue	.36	.22	.22	.58	.52	.38	.57	.41	.60	.37	.45	.28	.18	.39
Magnesium	% total residue	3.2	2.4	5.2	4.4	5.4	3.9	6.6	5.9	9.2	5.1	5.3	4.1	7.1	3.8
Silicon	% total residue	.044	.021	.050	.033	.025	.014	.018	.031	.011	.005	.012	.008	.020	.038
Boron	% total residue	.044	.029	.038	.033	.018	.040	.055	.046	.041	.031	.076	.061	.11	.040
Aluminum	% total residue	trace	.00061	trace	nil	trace	nil	trace	.00041	.0049	nil	nil	nil	.0007	.001
Potassium	% total residue	1.7	1.5	2.3	2.7	1.9	1.7	2.6	2.1	2.7	2.6	2.0	2.1	2.5	1.6
Nitrate	ppm	1.10	1.08	1.20	1.05	1.10	1.10	.95	.92	1.12	1.10	.95	.94	.98	1.20
Total Phosphate	ppm	1.25	1.20	1.10	1.10	1.25	1.20	1.05	1.02	1.03	1.02	1.00	1.02	0.95	1.10

(1) % total residue determination accomplished by spectrographic analysis.
(2) parts per million determinations accomplished by standard wet chemical techniques.

1. From the maximum number of construction personnel anticipated at the site, the average sewage loading is estimated at 9.6 gal/min/8 hour working day.

2. From the permanent plant operating force the average sewage loading is estimated at 1 gal/min/24 hour day.

These loads would occur concurrently for only about six months during plant startup.

Plans for sewage disposal system have been completed and were submitted along with permit applications to both local and state control agencies. The general scheme incorporates septic tanks and a leach field. Design of this system is in accordance with the State Water Supply and Pollution Control Commission which has granted permit approval, and the United States Department of Health, Education, and Welfare.

g. <u>Stack emissions</u>

These emissions will include various substances, any of which are considered atmospheric contaminants. The three major contaminants emitted as a result of the combustion of fossil fuel oil are: particulate matter, sulfur dioxide (SO_2), and nitrogen dioxide (NO_2). If these and other such contaminants are not controlled to acceptable levels in accordance with the New Hampshire State Air Pollution Control Commission Regulations, ground level deposition of soot or potentially corrosive acids could occur, in addition to the potential toxic effects of high concentrations of SO_2 and NO_2.

Newington Station has been designed to control air pollution by reducing and adequately dispersing stack effluent components. As required by New Hampshire State Air Pollution Control Commission Regulations, maximum sulfur content of the fuel used will be 1%, resulting in low emissions of sulfur dioxide. In addition, oil additives will be used which will reduce SO_2 emissions. Formation of nitrogen dioxide will be minimized by reduction of excess air in the fuel-firing process (to about 3%) by use of tangential firing. Particulate emissions will be controlled by means of an electrostatic precipitator. The stack will be built to the maximum height allowed by the Federal Aviation Administration clearance requirements (410 feet) and utilization of a high exit gas temperature (510°F) will facilitate plume dilution by dispersion. Also, combustion air preheaters will heat incoming air to 260°F with a resultant improvement in stack effluent quality and appearance especially during startup periods. The stack gases will exit at a velocity of approximately 80 feet per second and the particulate loading on the outlet of the precipitator will not exceed 0.0005 grains/ACFM.

As a standard part of the Newington Station planning, Public Service Company of New Hampshire has commissioned Jackson and Moreland Division of United Engineers and Constructors, Inc. to perform air quality studies.

Analytical studies have been performed entailing concentration at ground level of the aforementioned air contaminants based upon planned operational parameters of the plant. These predictions are summarized in Table 19 and compared to ground level ambient concentrations that were measured around the area.

TABLE 19

NEWINGTON STATION-UNIT NO. 1

MAXIMUM GROUND-LEVEL CONTAMINANT CONCENTRATIONS (PPM)
(Based on 2% Sulfur Content Fuel and Full Load Operation)

	Stability	Downwind Distance (Meters)	SO_2	(2) SO_3	(3) H_2S	(4) NO_2
PREDICTED ONE-HOUR AVERAGE CONCENTRATIONS	A	1,100	0.095	0.002	0.002	0.048
	B	2,000	0.076	0.002	0.002	0.035
	C	3,000	0.047	0.001	0.001	0.021
	D	8,000	0.021	0.001	0.001	0.010
	E & F	10,000	<0.01	<0.001	<0.001	<0.01
	Elev. Inv.	6,000	0.140	0.003	0.003	0.064
PREDICTED 24-HOUR AVERAGE CONCENTRATIONS	Stability varying (1)	1,000	0.003			
		1,500	0.004			
		2,000	0.005			
		2,500	0.006			
		3,000	0.007			
		3,500	0.008			
		4,000	0.008	<0.001	<0.001	0.004
		5,000	0.007			
		6,000	0.007			

(1) 24-Hr Stability Distribution:
A - 1 Hr., B - 2 Hrs., C - 3 Hrs., D - 12 Hrs., E&F - 5 Hrs., Elev. Inv. - 1 Hr.

(2) Based on a maximum of 2% of the fuel sulfur content being emitted as SO_3.

(3) Based on a maximum of 2% of the fuel sulfur content being emitted as H_2S.

(4) Based on a stack gas NO_2 concentration of 550 PPM.

Comparison is also made to allowable concentrations given by several states. In addition, a comparison is made to the national Ambient Air Quality Standards promulgated by the Environmental Protection Agency.

Preliminary estimates by the applicant, indicate that ground level concentrations of the contaminants emitted from Newington Station will be well below federal and state Ambient Air Quality Standards even under adverse meteorological conditions. The study also indicates that combined emissions from both Schiller and Newington Stations do not appear to exceed the present state Ambient Air Quality Standards.

h. Noise emissions

In recognition of residential areas near the plant site (across the river) attention has been given during plant design to avert propagation of unnecessary noise which would be physically annoying.

No state or municipal criteria are currently applicable to the proposed plant which define acceptable sound levels in the area. Very few communities outside of New Hampshire have promulgated noise standards. In addition, there are no published federal criteria or standards covering ambient noise levels from stationary sources. The applicant has reviewed criteria for locales similar to Newington, selected appropriate criteria for permissible offsite noise levels and adopted these as a design objective for the plant. Selection of these criteria bear cognizance of the possibility that noise control requirements will be forthcoming and proper attention to this area of concern at this time should obviate the necessity of future retro-fit.

i. Land usage

Land usage by construction of the electrical generating plant certainly influences both the immediate and surrounding environment. Clearing of existing vegetation and grading, along with erection of structures and associated equipment, will affect both the plant and animal populations of this 54 acre tract of land.

The main plant will consist of a boiler room, turbine hall, administration wing and shops. Other plant facilities will include circulating water intake and discharge structures, stack electrostatic precipitator, fuel oil piping and storage tanks, gatehouse, construction offices, warehouses and shops, water and sewage systems and associated 345KV switchyard.

Prior to Public Service Company of New Hampshire acquisition, this land was partially used as an apple orchard; however, production has ceased many years ago and the intrusion of pine, elm, cedar, oak, and ash trees has taken place. Wildlife residing here includes a variety of passerine birds, pheasants, ruffed grouse, mice, shrews, rabbits, and fox. An unnamed brook runs through the property but supports little in the way of aquatic life due to pollution from outside sources and a very low flow.

Efforts are being made to preserve as many of the original land features as is feasible, and to maintain a natural screen around this site. To protect trees and shrubs from damage during construction, temporary fences have been erected around these areas which are to be preserved. Final landscaping of the completed station will be directed by a consulting specialist.

Preservation of indigenous plant life should ensure some measure of protection for associated fauna.

The brook on-site will remain unaltered except for culverts placed at two road crossings. No station wastes, either treated or untreated, will be discharged into it.

The Town of Newington has zoned the plant site as an industrial district, therefore, no variance or rezoning was necessary. Application for a Building Permit was executed on August 17, 1970. Attached to the application were preliminary drawings showing site layout and a brief description of the intended work. Approved permit was received by Public Service Company on September 3, 1970.

The plant itself and its associated substation have been located on the site to best utilize the topography and existing tree cover to screen the lower portions of the development. Access roads are laid out and trees and shrubs transplanted to minimize line-of-sight views from off the site.

The perimeter security fence that has been erected is in a dark green color to minimize its presence.

The upper elevations of the plant and its adjacent stack cannot be screened, but every effort is being made to keep their appearance aesthetically pleasing. The siding color will blend with a neutral sky and the roof mounted equipment will be screened by material in a like color. The building will feature a horizontal band of backlighted translucent panels around the top.

Permission has been obtained from the Federal Aviation Administration to display flashing strobelights on the stack during daylight hours rather than the standard orange and white airway obstruction marking paint.

The substation and associated transmission structures will be designed for an orderly and low profile appearance as possible. Steel structures will only be utilized where necessary; otherwise wooden structures to compliment the semi-wooded environment will be used.

4. ADVERSE ENVIRONMENTAL EFFECTS WHICH CANNOT BE AVOIDED SHOULD THE PROPOSAL BE IMPLEMENTED

As outlined in the previous section, Public Service Company of New Hampshire has already received state and local permits covering discharge of cooling water, discharge of residual chlorine, sewage disposal, building construction and discharge of station wastes. An application is currently pending

4. ADVERSE ENVIRONMENTAL EFFECTS WHICH CANNOT BE AVOIDED SHOULD THE PROPOSAL BE IMPLEMENTED.

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a. Noise

Although, at present, no regulatory criteria exists for control of noise emissions, Public Service Company of New Hampshire has designed Newington to isolate objectionable noise sources. Once these sources are identified and quantified, corrective abatement measures can be planned. It is believed that this foresighted approach will produce sound levels acceptable to the general public, and in addition, comply with future regulatory criteria.

b. Air

Currently, regulations for the control of air quality in New Hampshire are based essentially upon emission control. They require use of fuel with prescribed limitation of sulfur content as a means of controlling sulfur dioxide emission. In addition, the regulations state that emissions from newly-constructed fuel-burning equipment be no darker than No. 1 on the Ringlemann Smoke Chart. These regulations are administered by the New Hampshire State Air Pollution Control Commission.

Recently, the Environmental Protection Agency promulgated standards of ambient air quality. These standards cover ambient levels for the following contaminants: sulfur dioxide (SO_2 indexed), particulate matter, carbon monoxide, photochemical oxidants, hydrocarbons and nitrogen oxide. The expected enforcement date for these regulations is July 31, 1975.

By careful analysis of engineering features regarding fuel composition, firing method, and stack characteristics, a prediction was made of both emission rates and far-field effects on ambient air quality. The applicant feels that based on this analysis, Newington Station will conform to existing state standards as well as applicable promulgated Environmental Protection Agency standards and that Newington in concert with Schiller Station will not exceed regional ambient air quality standards.

c. Ecology and Water Quality

Public Service Company of New Hampshire in cognizance of the possibility of subtle, unforeseen environmental effects has initiated monitoring programs in several areas. Water temperature of both the mixing zone and far-field stations will be monitored continuously. An ecological and physical parameter monitoring program encompassing a ten (10) year period will be conducted by an independent bio-environmental consulting firm and by qualified personnel of Public Service Company of New Hampshire.

In the case of the proposed 400 MWe Newington Generating Station, the current monitoring program being conducted by Normandeau Associates Inc.

"address the following questions:"

What will be the temperature rise of the estuary as the result of plant operation and will this temperature rise affect the marine life in the estuary?

Will the discharge of heated effluent interfere with fish migration?

Will the Δt have a significant effect on entrained organisms?

Will construction and operation of the plant produce significant local ecological changes?

The following represents a summarization of predictions by Normandeau Associates Inc. based on present studies (data presented in Section 2) and literature research.

Calculations by Jackson & Moreland, presented in a report in support of application for Water Use Permit and submitted to the New Hampshire Water Supply and Pollution Control Commission, show that an increase of less than $1^{\circ}F$ can be expected in the Great Bay and Little Bay estuaries as the result of the operation of Newington Generating Station. Since natural temperature variability throughout the estuary is considerable, a temperature increase of this magnitude will not have, in the applicant's judgement, any measureable effect on the biota of the estuary.

The discharge of heated effluent from the proposed unit has been studied by Jackson & Moreland and dispersal dynamics have been described. This study indicates that no thermal barrier should develop across the channel as a result of released heated effluent.

Since the present discharge from the Schiller Generating Station has apparently not interfered with fish passage, there should be no significant interference with migration of fish into and out of the estuary as a result of additional thermal release.

Entrainment of plankton, including the larvae of many important fish and shellfish, should not result in any significant ecological disruption. The relatively small volume of water which will pass through the power plant in comparison to the volume passing by the plant on any tidal cycle indicates that only a small percentage of the plankton would be subjected to entrainment.

Disruption of the local biota will result from construction and operation of this power plant. However, it is expected that this will be minimal. There are no concentrations of sport or commercially important bivalves in the area of discharge and because of the surface method of release, the adult lobster, Homarus americanus, will probably not be subjected to any significant temperature increase.

It is the opinion of the Army Corps of Engineers that the present ecological survey program, based on the information contained in the Environmental Impact Statement Newington Station Unit No. 1, February 1971 prepared by Public Service Company of New Hampshire and Report No. 1 on the Piscataqua River Ecological Study 1970 Monitoring Studies by Normandeau Associates, Inc., being descriptive and inventory in nature does little to support the aforementioned predictions. Further, emphasis has not been given to the full range of potential effects that Newington Station might have on the Piscataqua River complex. The biological sampling and measurements of physical parameters should be intensified on a year-round basis and directed more towards the aquatic environs in the immediate area of the proposed plant site. In short, the Corps emphasizes a needed in-depth study of local effects in conjunction with the present plant site as well as the total estuary approach.

One of the most important aspects in analyzing or predicing effects of temperature change on a fishery is to examine those individual species important to the specific water body under study. The Piscataqua River-Great Bay complex is inhabited by several important migrating species including smelt, alewifes, herring, mackerel, and striped bass. Recently, extensive efforts have been successfully expended in the re-introduction of coho salmon. Unfortunately, the population dynamics and migrating behaviror of these species within the watershed are virtually unknown and this lack of data prohibits a realistic appraisal of plant operation effects on this resource.

Effects of thermal effluents upon migrating fishes has, in general, received relatively little attention. While some species are known to avoid heated waters, others such as striped bass are attracted to it and often become trapped in water intake. Striped bass can, however, tolerate extreme high temperatures for relatively long time periods providing a somewhat gradual acclimation is possible. Other species such as smelt, alewife, and salmon are less tolerant and more susceptible to deleterious influences promoted by such conditions.

While the Corps is inclined to agree that no thermal barrier should develop, it must be recognized that the river narrows considerably immediately downstream of the discharge in the vicinity of Boiling Rock. Combined heated effluents from Newington and Schiller Stations could conceivably span the cross-sectional channel area at this particular point, creating a thermal deterrent to migrating fish. Normandeau Associates, Inc. feels that the considerable mixing occuring in river areas receiving the discharge will render the thermal conditions relatively harmless to exising biota. We assume that migratory fish are included in the word "biota". However migrating fish might well be deterred from passing the point even though temperatures are not lethal. Biologists from the Atlantic Sea Run Salmon Commission report that adult salmon will not enter rivers at temperatures of 23°C (73.4°F) or above, and migrating activities may be drastically reduced at temperatures ranging from approximately 20°C (68°F) to 27°C (80.6°F), and although not directly lethal to salmon (Atlantic salmon), will increase oxygen requirements. Dissolved oxygen concentrations below 5mg/l could produce a block to salmon and other migrating fish. Oxygen measurements shown in Table IV, Page 23 indicate high saturation levels although no records were made during the month of August, which can be compared with the critical "20°C eleven (11) day" period. Also, the actual sampling station (Station 3, Red Nun Buoy) for temperature and oxygen is approximately 1,500 to 2,000 feet upstream from the proposed intake-discharge facilities and mixing zone area. In addition to thermal blockage and insufficient oxygen, sudden temperature rises of 10°F to 15°F will cause serious shocking effects to most species of fish regardless of life cycle stage. Generally speaking, thermal tolerance ranges increase with age and size for most fish species. However, optimum temperatures for adult fish are usually somewhat lower than those for juveniles.

Any effects would probably be most noticeable at the surface and particularly at slack water intervals. The water exchange rate, which is known to take several tidal cycles for completion, could maintain these heated waters within the channel area in reference. This "siting" effect coupled with peak electricity requirements in summer could coincide with any excessively occurring high temperatures during the period from July through September and thereby enhance deterrent or adverse possibilities. These assumptions in any case, would seem to merit more refined studies before a positive prediction can be rendered.

For the reviewer's reference, temperature limits for various fish species known to inhabit the Piscataqua River-Great Bay Estuary are presented on the following page.

With regard to entrainment of plankton, not enough is known about larvae and juvenile stages of organisms, both fish and invertebrates, in the Piscataqua River to predict effects of heated water on them. Spatial and temporal distribution of zoo plankton, especially, fish eggs and larvae and bivalve larvae, should be determined over a full 12-month period. This information is needed before reasonable estimates of mortality rates, based on time-at-temperature, chlorine and possible mechanical effects through the cooling system, can be determined. It was recently learned that the University of New Hampshire has collected approximately 1½ years worth of data on fish larvae and eggs. Samples have been obtained on a monthly basis at both surface and bottom depths and during day and night hours. Results of analysis, when completed, will provide much needed information on this important subject area.

Entrainment of planktonic organisms is not merely a matter of water volume alone as implied in the applicant's prediction (Page 4), but what is important is the percent composition of a total species population contained in a given volume of water at a given time. For example, larvae and juvenile fish could concentrate at the intake elevation only at certain times of the day or at a particular tide stage. These factors are not related to the total volume of a tidal pass. Also, since the intake is actually drawing in water at a given velocity, the amount of plankton taken in will be disportionately larger than say a same volume of water passing the plants on

LETHAL TEMPERATURE LIMITS FOR ADULT MARINE, ESTUARINE AND ANADROMOUS FISHES

Species	Acclimation Temperature °C	Acclimation Temperature °F	Lower Lethal Temperature °C	Lower Lethal Temperature °F	Upper Lethal Temperature °C	Upper Lethal Temperature °F
Alewife	---	---	---	---	26.7-32.2	80.0-90.0
Bass, striped	---	---	6.0-7.5	42.8-45.5	25.0-27.0	77.0-80.0
Salmon (general)	---	---	0.0	32.0	26.7	80.0
Common silverside	7.0-28.0	44.6-82.4	1.5-8.7	34.8-47.8	22.5-32.5	73.3-90.3
Flounder, winter	21.0-28.0	69.8-82.4	1.0-5.4	33.8-41.6	---	---
" "	7.0-28.0	44.6-82.4	---	---	22.0-29.0	71.6-84.2
Herring	---	---	1.0	30.2	19.5-21.2	67.1-70.1
LETHAL TEMPERATURE RANGES FOR YOUNG						
Herring	7.5-15.5	45.5-59.9	-1.8 to -0.75	28.8-30.7	22.0-24.0	71.6-75.2

NOTE: Data extracted from Federal Water Quality Office, 1968. Industrial Waste Guide on Thermal Pollution.

any given tidal cycle. It was also pointed out earlier in this statement that for various reasons environmental effects or lack thereof, at Schiller Station should not be equated to the proposed Newington Unit No. 1. In fact, the 3/8" traveling screen mesh operating at Schiller would permit passage of larvae and even some juvenile fish into the condensers. Also the shoreline configuration directs the seaward currents and any planktonic or nektonic organisms out into the main channel where they may be swept away from the intake structure.

In order to confirm or disprove conclusion(s) relative to the alteration of aquatic environment, Public Service Company of New Hampshire is committed to a ten-year preoperations/operational ecological monitoring program. The studies are a continuance of the type presented in Section 2 of this statement. Studies were implemented in 1971 on intertidal organisms, benthics, epi-benthics, plants, and oysters. The intertidal program encompasses both muddy and rocky habitats. Intertidal and subtidal benthic studies utilize replicate sampling (10 quadrats/station and 5 grabs/station, respectively) and then are subjected to statistical analyses. Oyster studies comprise growth rates, mortality rates and sport settlement.

The applicant's ecological consultant has further informed the Corps that species composition and diversity of zooplankton and phytoplankton communities are being monitored at Station 3 on a monthly basis with replicate samples at surface and 8 meter depths on both ebb and flood tides. Also, fish eggs and larvae are sampled on a biweekly basis using coarse mesh meter nets. Each of these programs has been or will be increased this year. A new plankton station has been established at the Newington intake facility, and meter nets will be used in this area on an intensive exploratory basis to determine spatial and temporal distribution of fish eggs and larvae.

In addition, an extensive fisheries program including seining and trawling, sonic tagging of striped bass and coho salmon, and creel census for striped bass and rainbow smelt is underway. Past efforts were stymied by an inability to obtain specimens which was not extirely the fault of the applicant. At a meeting in May 1972, the New Hampshire Fish and Game Department granted permission for the applicant to utilize gill nets in capturing fish which should facilitate the tagging efforts.

Normandeau Associates, Inc. will provide on or by June 1 of each year an annual report detailing all study activities for the previous year. This report will incorporate: (a) an analysis of all service program results, (b) a presentation and analysis of permanent monitoring station data, (c) a detailed analysis of infrared overflights and all other special programs, (d) a presentation of overall conclusions regarding existing conditions and detection of significant trends in environmental quality, and (e) recommendations for any modifications in the overall monitoring program.

During planning, implementation and analysis of these monitoring activities Normandeau Associates, Inc. will seek out opinions, recommendations and advice from pertinent Federal and State regulatory agencies. Copies of the annual report will be provided to the Corps, EPA, the National Marine Fisheries Service, Bureau of Sport Fisheries and Wildlife, New Hampshire Fish and Game Department and any other interested regulatory agency.

In addition, station waste surveillance will include monitoring of chlorine levels in the circulating water system and monitoring of other station wastes. Air quality checks will be accomplished by both stack and ambient air monitoring. Noise levels have been investigated to give a baseline picture of existing noise sources. Future follow-up of this study should provide data to assure environmental protection regarding noise pollution.

The Corps of Engineers has prepared additional recommendations designed to expand the present baseline monitoring program and these are presented in the beginning of this final statement as conditions for protection to the Piscataqua River Estuary environment.

5. ALTERNATIVES TO THE PROPOSED ACTION

Site and Generation Method Selection

The selection of a fossil fired electric generating station in Newington at the site proposed in this application was the result of evaluating several alternatives.

In 1966, the applicant forecast power requirements through 1975 based on past years' experience, with adjustments for anticipated population growth and industrial expansion.

The following methods of generation were evaluated:

a. Conventional hydro.

b. Pumped hydro.

c. Fossil fuel thermal.

d. Nuclear fuel thermal.

e. Combustion turbine thermal.

The State of New Hampshire was carefully surveyed to determine the relative effects, both environmentally and economically, using the various methods outlined above, with the following conclusions:

a. No significant conventional hydro can be developed due to lack of economic sites as a result of small rivers with very irregular flows.

b. Pumped hydro sites exist in number with at least 15 sites worthy of full engineering study. However, pumped hydro installations must be correlated with thermal units, preferably nuclear, to provide the lowest possible cost. Therefore, until additional major thermal units are installed, the pumped hydro sites must be set aside.

c. Fossil fuel thermal units can be installed at many locations. However, they fall into two basic categories: first, those using tidewater for cooling purposes and fuel delivered by sea-going vessels, thereby requiring coastal siting; and second, those located inland on main rivers such as the Merrimack, but nearer to load centers, requiring fuel transportation and some form of supplemental cooling for condensing water since the rivers in New Hampshire do not have adequate flows 12 months of the year for once-through cooling systems.

d. Nuclear fuel thermal units can be installed at several locations, but much more selectively than for fossil fuel. Although inland sites could possibly be used with supplemental cooling, sites located on tidewater are preferable both from environmental and economic evaluations.

e. Combustion turbine units are small in capacity and do not meet bulk power generation requirements. However, they are flexible and can be located at many locations throughout the system where they would be used for peaking and system back-up service.

From the forecasts and evaluation of desirable generation mix, it was determined early in 1967 that a nuclear unit for an in-service date of 1974 should be selected. From the site evaluation, it was determined that a site in Newington would be the most advantageous. Work was started, and contacts were made with regulatory agencies, including the Atomic Energy Commission. The site appeared to meet all the basic requirements. After further evaluations, a size of 860,000 kilowatts was selected. A pressurized nuclear steam supply system and turbine-generator were ordered from Westinghouse Electric Corporation for an in-service date of October 1974.

In August 1968, the Atomic Energy Commission informed the applicant, that the criteria had been established for the Newington site requiring extensive engineering safeguards due to the fact that Pease Air Force Base was located in the vicinity. After extensive engineering efforts by the applicant, proved the criteria could not be met and maintain planned schedules and safeguards probably could not be engineered, an alternate site, at Seabrook, New Hampshire, was selected for the location of the nuclear station. This occured in late 1968, and although valuable time has been lost, it was believed that the 1974 in-service date could still be met.

Although concentrated effort was given to the job during the following months, it appeared in early summer of 1969, that the 1974 in-service date was in jeopardy due to delays in regulatory permit action and slippage in deliveries of material.

Since the applicant required a minimum of 400,000 kilowatts of new capacity in 1974 and since no alternative source could be found outside of New Hampshire from neighboring utilities, the applicant in the summer of 1969 placed orders for an alternative fossil fired unit of 400,000 kilowatts capacity to be in service in 1974.

To proceed with both units, the fossil unit in 1974 of 400,000 kilowatts and the nuclear unit which had now slipped to 1975, created surplus power in 1975 which required relief because of the heavy fixed charges on unused capacity. Therefore, an offering of capacity was made in August 1969 to all electric systems in New England, both privately owned and publicly owned. Although some interest in the capacity was received from both privately and publicly owned systems, not enough power was requested to take up the surplus. Therefore, in November 1969, the Seabrook Nuclear Station was deferred.

With the 400,000 kilowatt fossil fuel unit as the alternative, the question to be resolved was location. The following siting problems existed:

a. Type of unit - - base vs cycling.

b. Coal vs. oil fired.

c. Coastal vs inland.

Each of these questions was carefully analyzed. Since the applicant's planned generation mix indicated need for a nuclear unit, it appeared desirable to protect the base portion of the load curve for future nuclear generating facilities. Therefore, a fossil plant capable of cycling duty was selected. When this decision was made, it basically selected the fuel as oil, since coal is not as flexible a fuel for cycling duty as oil. Oil is more available at lower cost with less potential effect on the environment but should be located on tidal water. The condensing cooling problems are much less severe when utilizing the cold waters of the Atlantic Ocean than an inland river. Therefore, the alternative appeared to be a plant that should be cycling, burn oil, and be located on the coast.

The next question to be answered was where on the coast should the unit be located. The Company owned three sites on the Piscataqua River, a tidal river running northerly from Portsmouth Harbor into Great and Little Bays. Each of the sites met the basic requirements. However, further consideration was needed on minimizing the impact upon the environment. The following items were considered:

a. Transmission lines.

b. Cooling water.

c. Meteorological conditions and effects of the station on air quality.

d. Noise from the station.

e. Potential treatment of design to maintain a high degree of compatibility of design with surroundings.

Each of the sites owned met most of the desired requirements; but after careful study, it was decided that another new location provided lesser overall impact upon the environment than the three sites owned by the applicant.

Therefore, the applicant acquired the new site in Newington, containing 54 acres. This site reduced the need for new transmission lines to an absolute minimum by utilization of existing right-of-way. From current studies, it was apparent that the desired mixing of water from the condenser with river water should be adequate to meet standards established for the estuary. Although controlled by the proximity of the Pease Air Force Base, the height of the stack of 410 feet was higher than allowable at a northerly site, which together with an electrostatic precipitator, would minimize the effects of emissions from the stack. The terrain at the site afforded an excellent opportunity to minimize noise effects; and by careful utilization of plantings, together with natural growth that could be left undisturbed, an "aesthetically pleasing" station is currently being constructed.

Condenser Cooling System and Discharge

Prior to acquiring the site for Newington Station Unit No. 1 Public Service Company of New Hampshire had conducted cooling studies in conjunction with a then proposed nuclear generating station at the Rollins Farm site, 1.2 miles upstream from the location of Newington Station. From these studies Public Service Company of New Hampshire felt that the desired mixing and quantities of water in this reach of the Piscataqua River were adequate to meet the established standards for the estuary. Based upon the results of these studies, and present state of art, Public Service Company of New Hampshire decided that further consideration of a supplemental evaporative cooling system with salt water cooling towers and/or spray ponds was not necessary.

Since the aforementioned studies, in the opinion of the applicant, indicated that standards for the estuary could more easily be met further downstream, a site (Newington Station) was purchased with no plans to accommodate these supplemental evaporative cooling schemes. Based upon experience gained at Schiller Station and a report, "Study of Circulating Water Discharge", Newington Station Unit #1, dated July, 1970, a decision was reached (by PSNH) to utilize the currently proposed and more economically feasible method of surface discharge. The results of this study are presented in Section 3 and illustrated in Figures 23 through 25A. The data indicates that the zone of passage is, in fact, near critical conditions under slack tide conditions and if this condition holds true after operation no further units will be permitted without adequate cooling facilities.

The Corps has included as part of its conditions for operation that investigations of alternate cooling methods be pursued.

Biofouling Control

The Corps of Engineers and Environmental Protection Agency, with visions of phasing out the use of chemical biocides, encourage consideration of alternate techniques for fouling control in circulating water systems. Some examples of alternate methods not involving use of toxicants are:

(a) Periodic recycling of hot water 85° - 105°F through the system will reduce fouling. Public Service Company of New Hampshire has informed the Corps that back pressure limitations in the low pressure turbine to be used at Newington will restrict any attempts to raise the temperature of recirculated water above 100°F. To achieve a recirculated water temperature of approximately 100°F in the intake and condenser system, about 40% of the normal circulating water flow would be discharged to the estuary at temperatures over 120°F.

(b) Mechanical devices are available for keeping condenser tubes clean. Injection of Amertap rubber or abrasive balls in the condensers have proved successful at some plants. This type of system however is limited to cleaning only a portion of the circulating water system.

(c) Reversal of water flow through condensers is technically feasible and has been successfully applied in some plants.

(d) Flushing the cooling water system with fresh water would kill the fouling organisms via osmotic damage. This process would involve 3 or 4 days down time and could possibly be accomplished during the weekend shutdown period as proposed for Newington.

(e) Smith, 1946 (Quart. Jour. Fla. Acad. Sci 9) found that a stream of air bubbles bathing a sea - immersed surface will maintain it almost free of fouling.

(f) Variations in the entry length of the conduit may serve to increase the flow velocity along the walls, thus inhibiting attachment of biofouling organisms. Fluid shear near the walls decreases with increasing length ultimately reaching a steady state. Fouling density generally corresponds to shear reduction (Board and Collins, 1965). It is technically possible to design intake approach velocities without increasing the potential of fish entrapment and still achieve shear reduction necessary to reduce or inhibit fouling.

(g) Another control method of biofouling and corrosion is the application of epoxy adhesive compounds which inhibit settlement. These compounds must be applied initially to clean surfaces for maximum adhesive and protection. Application of epoxy resin coatings can be performed on wet surfaces and even under conditions of total submergence.

(h) The Naval Ship Research and Development Center, Annapolis has recently announced that they have developed biocidal organometallic polymers which will be formulated into desired antifouling coating. The organometallic agent is chemically banded to the synthetic polymer backbone. The coating is reputed to be long lived and non-polluting. The organometallic polymer coating can be applied to underwater cabling and piping for protection against macrofoulants.

(i) A recent study by the Paint Laboratory, Naval Shipyard, Mare Island, California has suggested that a-c currents are often able to delay fouling settlement.

All of the aforementioned methods, while admittedly not preventing fouling entirely, have demonstrated varying degrees of success in its control. The major objection to many of these methods is the relatively high initial investment involved.

6. THE RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

The relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity is of paramount concern. The applicant has given careful consideration to the design of the station and its associated facilities to assure minimal environmental impact and to negate long-term risks to the health and safety of its neighbors.

The land upon which the Newington Station is being built is industrially zoned which clearly indicates sanction of this type of development for the area by local officials. Industrial zoning, however, should not be considered by the applicant as a license for unrestrained usage of land. In keeping with this policy, the applicant has made considerable effort to preserve as much as is practicable. General methods employed in maintaining some measures of site preservation are selective cutting and tree transplantation, low profile construction wherever possible, utilization of topography and vegetative cover to screen aesthetically objectionable station features, and use of natural colors to further camouflage the installation.

The 54 acre construction site has been considerably altered from its once pristine state and may never recover its natural primitive appearance. However, all of the site will not be affected. During actual construction, an estimated 40 acres may be involved either as erection sites or for associated procedural operations. Upon completion, the land not actually occupied by station structures and support facilities will be returned to pre-construction state by natural succession or in some cases aesthetically enhanced by landscaping. According to the applicant, the operational station including its related facilities will occupy approximately 20 acres.

If in the future the need for land dictates the restoration of the Newington site to pre-plant conditions, there is no technological problem to prevent this. However, in this time of rapid population growth with accompanying increase in power demands, this contingency seems remote. Substantiation for the possibility of land restoration lies in the past record of this area. What once was prime forest was cleared for agricultural use including the planting of apple trees. Later, orchard management and productivity were discontinued with subsequent intrusion of second growth trees. If in the future, station buildings and equipment were removed, vegetational succession would again proceed and eventually a flora and associated fauna similar to pre-plant conditions would result.

To the best of the applicant's knowledge neither properties listed in the National Register of Historic Places nor properties under consideration for nomination to the National Register are affected by Newington Station Unit #1. Excavation and grading of the site was substantially completed in late 1970 with minor excavations continuing up to the present. No archeological resources were known to exist on the project site prior to excavation and the applicant has stated that the site has no known historical significance. Prior subsurface borings and excavations have not turned up any artifacts or indicated anything of possible historic interest. The remaining excavation is substantially below water and will be done by underwater methods.

Productivity and standing crop for the Piscataqua River Estuary was determined by the light/dark bottle technique. Chlorophyll a was also measured using the trichromatic technique described by Strickland and Parsons, 1968. Commencing in 1972, photosynthic studies will be based on the C^{14} method which the applicant feels will provide more precise measurements. The studies will provide baseline data which will assist in the determining of the effects of plant operations on primary productivity. The relationship between chlorophyll a levels and photosynthetic rates will be elucidated. Some general conclusions have been reported in Report No. 2, by Normandeau Associates, Inc. 1971 Monitoring Studies.

Public Service Company of New Hampshire has indicated that they are presently expending efforts in a search for the most efficacious and practical means of beneficially utilizing the warmed effluent waters of Newington Station.

During its operation, the Newington Station is not expected to affect waterfowl water use or recreational boating.

The additional power generating facilities mentioned by the Environmental Protection Agency and as reported in a memorandum published by Public Service Company of New Hampshire entitled "Planning for the Year 2000" develops New Hampshire's power requirements out through the year 2000 and describes an expansion pattern that will provide these requirements using five sites that are presently owned by Public Service Company of New Hampshire. One is a nuclear site in Seabrook, New Hampshire presently under consideration for two 1100 MW units scheduled for commercial operation in 1979 and 1981. Two others are fossil or nuclear sites in the Merrimack River Valley at Concord and Litchfield and both will require a supplementary cooling system for circulating water. The Rollins Farm site on the Piscataqua River in Newington, New Hampshire, approximately 1.2 miles upstream from the Newington Station site is said to be suitable for fossil generation and in the future may be suitable as a nuclear generating site. This site will also require supplemental cooling of the circulating water before returning it to the Piscataqua River. The fifth site in the aforementioned memorandum is a possibility of an additional unit at the present Newington Station site. At present, Public Service Company of New Hampshire has indicated that there are no specific plans for the installation of any type of generating units at any of these sites except for two nuclear units at the Seabrook site and a second unit at Newington. The form of such future generation for these other sites, including the types of fuel, their circulating water requirements, noise levels, aesthetic appearance and all other factors that affect the environment will require careful consideration and evaluation. Public Service Company of New Hampshire will be required to comply with regulations in effect at the time any future installations are scheduled at any site. Where future sites are on the same waterway or in close proximity to each other so as to affect air quality or other ecological and/or environmental parameters, they will require appraisal as a composite group.

Maintenance of acceptable air quality standards by the adoption of a clean stack policy should prevent deleterious effects to the atmosphere. Impairment of air quality is further checked by monitoring of particulate matter in stack emissions. Long-term effects and concomitant foreclosure of future air options and/or needs are additionally assured by the natural reversibility of atmospheric pollution.

Water quality maintenance is so regulated that adverse effects on long-term productivity are limited by adherence to proper standards. Some short-term effects (e.g. turbidity, siltation, increased BOD) will result from the actual dredging operation required for installation of intake and discharge structures. Initially the immediate dredged area, approximately three acres, will be sufficiently altered such that the existing intertidal and benthic community will be destroyed. The dominant species involved here are such invertebrate animals as razor clams (both Ensis and Tellina) and several polychaete worms (Nephtys, Nereis and Clymenella). Commercially important soft-shelled clams and crabs (Cancer irroratus) have been taken in this area but are not in sufficient numbers to warrant harvesting. Occasionally, lobsters have been noted in this area but their presence, judging from the lack of lobster pots here, is not considered significant. Attached algae is sparse in this area due to lack of available hard substratum. Dominent algae are Ulva lactuca and Enteromorpha sp.

Following the installation of intake and discharge structures, a biotic recovery, in part, is expected in the affected area. The composition of such a developing community, time period and degree of recovery are uncertain at this time since local physical features, i.e. current velocities, shoreline and temperature will be altered from their original state. The extreme temperatures may well render a near sterile bottom condition in the discharge flume. However, existing plant and animal populations reported in the area of influence by Schiller Station intakes and discharges suggest that viable communities may become reestablished under such conditions.

Addition of the biocide sodium hypochlorite may have a long-term ecological influence on potential fouling organisms (mussels, tunicates and ectoprocts) actually contained within the plant circulating water system, especially the intake portion. Chlorination will subject equally damaging stresses on fish eggs and larvae and other types of plankton that might pass through the cooling water system. Public Service Company is prepared to initiate a continuous monitoring and alarm system as a standard procedural operation while the biocide is being injected. Other station wastes will only be released in concentration levels known to be consistent with sound water quality management.

Much concern has been voiced regarding the possible harmful effects of heated water on aquatic life, especially on anadromous fish resources which represent an important source of state revenue. Thermal additions may influence migrating fish in various ways and this issue seems sufficiently important to deserve more sophisticated consideration than has been received thus far. Life-cycle stages of virtually all aquatic animals, boreal species in particular, are adapted to relatively narrow ranges of seasonal and short-term temperature variations. Acclimation by these organisms towards upper temperature levels such as those conditions imposed by thermal shock resulting from routine or emergency shut-down and start-up procedures, is more difficult to achieve.

7. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES WHICH WOULD BE INVOLVED IN THE PROJECT ACTION SHOULD IT BE IMPLEMENTED.

The construction and operation of the Newington Station Unit No. 1 will involve the commitment and use of land, air and water. While the quantity of land utilized can be specified (approximately 20 acres for the completed plant facility and an estimated 600 feet of shoreline for intake-discharge structures) the air and water usage is impossible to quantify as it depends on operational schedule and load. Although these resources are utilized, it is doubtful that such use constitutes an unalterable or irreversible disruption of the environment. The rationale here is that land, air and water are considered restorable to pre-plant conditions if in the future the power station was retired.

Other known and quantifiable resources considered irretrievable at Newington Station is the fuel oil that will be consumed in the generation of electricity and the labor and materials needed to construct the project.

There will be destruction of an unquantifiable number of aquatic animals by certain construction and operational procedures (e.g. dredging and entrainment-entrapment) but these populations, with the possible exception of some fish species, are considered capable of sustaining such impacts, being replaceable by natural recruitment.

During plant operation, there will be releases of heat, chemicals, liquid and other waste into the estuarine waters. The warm water will be discharged as described in Section 1. There might be an adverse effect upon anadromous fish resources if they are exposed to water temperatures greater than 80°F for extended periods or in the event of thermal shocking. Benthic populations in the immediate vicinity of the discharge may be expected to suffer high mortalities although these are not necessarily irrevocable. Any synergistic actions and combined influences from Schiller and Newington Stations can be positively identified within time.

The regulatory agencies at both State and Federal levels are currently studying in more detail alternate methods of intake design, travel screen types, and use of chemical biocides which hopefully will reduce any potential adverse effects to the estuarine resources. This, coupled with a comprehensive surveillance program (if and when the plant does go into operation) should serve to identify any effects that would curtail the diversity and range of beneficial use of the environment.

Literature Cited

1. Board P.A. and T.M. Collins, 1965. Physical forces in marine fouling. Discovery. 26 (5): 14-18.

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3. DeCola, J.N., 1970. Water quality requirements for Atlantic Salmon. U.S. Department of Interior, FWQA, New England Basins Office, Needham Heights, Mass. 39p.

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5. McLean, R.I., 1972. Chlorine Tolerance of the Colonial Hydroid *Bineria frustrana*. Chesapeake Sci. 13 (3): 229-230.

6. Strickland, J.D.M. and T.R. Parsons, 1968. A handbook of Seawater Analysis. Fish. Rec. 3d. of Canada. Bull. No. 167. 311p.

7. Yentsch, C.S. and D.W. Menzel, 1963. A method for the deterioration of phytoplankton chlorophyll and phaeophytin by fluorescence. Deep-Sea Res. 10:221-231.

8. COORDINATION WITH OTHER AGENCIES

Draft environmental statements concerning the construction and operation of the Newington Electrical Generating Station Unit No. 1 (March 1972) were furnished to the following Federal, State, and local agencies as well as to citizen groups who have expertise, responsibilities, and/or interests in the proposed project:

National Marine Fisheries Service
Bureau of Sport Fisheries and Wildlife
Bureau of Outdoor Recreation
U.S. Coast Guard
New Hampshire Natural Resources Council
Audubon Society of New Hampshire
Seacoast Anti-Pollution League
The Committee on the Atlantic Salmon Emergency
Sierra Club
New Hampshire Recreation and Parks Society
New Hampshire Fish and Game Department
Federated Sportsmen's Clubs of New Hampshire
Jackson Estuarine Lab, University of New Hampshire
University of New Hampshire, Institute of Natural and Environmental Resources (Resources Development Center)
New Hampshire Air Pollution Control Commission
New Hampshire Office of State Planning
New Hampshire Water Supply and Pollution Control Commission
Maine Department of Sea and Shore Fisheries
State of Maine Environmental Improvement Commission
Town of Newington, New Hampshire
City of Portsmouth, New Hampshire
Town of Kittery, Maine
Town of Eliot, Maine

The draft environmental impact statement was formally issued on 24 April 1972 and the 45-day review period ended on 8 June 1972. An additional three week extension was allowed to facilitate those review schedules of other major regulatory and authorizing agencies. Comments were received by the following agencies:

Environmental Protection Agency
Department of Interior
Department of Commerce
Bureau of Sport Fisheries and Wildlife
U.S. Coast Guard
N.H. Office of State Planning
N.H. Fish and Game Department
N.H. Water Supply and Pollution Control Comm.
N.H. Air Pollution Control Commission
N.H. Public Utilities Commission
New England River Basins Commission
New England Energy Policy Staff
Normandeau Associates, Inc.
Jackson and Moreland

Copies of the comments of the above agencies are attached to the statement with the major points summarized below.

(1) Environmental Protection Agency

Comment: The survey nature of the ecological investigations should be expanded before completion of the facility to provide more information needed to assess the environmental impact.

Response: Public Service Company of New Hampshire has expanded the nature of their ecological investigations beyond the survey type conducted in 1970. This work is being conducted by Normandeau Associates, Inc. an independent bio-environmental consulting firm. The inadequacies of the monitoring program were presented by Corps biologists at a meeting with PSNH back in October of 1971. Since that time there have been several other meetings bwtween PSNH and biologists from the National Marine Fisheries Service, Bureau of Sport Fish and Wildlife, EPA and most recently the N.H. Fish and Game Department, which emphasized further to expand the ecological-environmental studies.

Comment: We (EPA) are concerned about the possible effects of entrainment upon meroplanktonic organisms indigenous to the estuary. Although some information has been provided by the applicant, it is too limited to illustrate seasonal and tidal distributions of plankton. The proposed entrainment studies should provide some important data, nevertheless, it is essential that this kind of information be available during preliminary steps in order to evaluate a priori the environmental effects.

Response: Public Service Company of New Hampshire initiated a study in November, 1971 on the effects of the circulating water system at Schiller Station to various plankters. These include bivalve larvae, copepods, tintinnids, rotifers, fish larvae, and other important plankters. Analysis is carried out such that data is gathered on immediate as well as delayed mortality. Sampling programs begun in 1971 and continuing this year are according to the applicant, designed to show the tidal, seasonal and spatial distribution of organisms particularly in the proposed Newington Station intake/discharge areas as well.

Comment: Although fish entrapment at the Schiller Station is not a serious problem, this conclusion cannot be extrapolated to the Newington Station. The only way in which the severity of this problem can be predicted is by developing a better understanding of the finfish habits and life histories in this estuary. Areas of concern include the frequency and size of migrations past the site, the susceptibility of these organisms to power plant intake flows, the proximity of spawning areas to the site, and any tendencies for species to congregate near the intake.

Response: The Corps concurs with this statement. The Public Service Company of New Hampshire will expand their current fisheries program. This will include seining and trawling (replicate monthly hauls at several stations over the course of the river), sonic tagging of striped bass and coho salmon, and creel census for striped bass and rainbow smelt. Each of these programs has, according to the applicant, been set up to facilitate statistical comparison from year to year, and the seining effort will be further augmented this year in the Newington area.

Comment: Alternatives to this project should be investigated, including alternative discharge or cooling methods and alternatives for condenser cleaning.

Response: The section on alternatives has been expanded to include a greater discussion of these points based on the limited information provided by the applicant. Only two methods of discharge were explored. These were surface and subsurface types. Alternate methods to use of biocides appear to have escaped attention altogether. However, studies were conducted concerning alternate cooling water systems, but this was accomplished in conjunction with the proposed nuclear generating station at the Rollins Farm site. This data was transposed to the Newington site, but no additional field investigations were performed. Consideration in the use of cooling towers, spray ponds or process changes were dismissed on the pretense that the Newington site would satisfy current estuarine water standards. Unfortunately, the data presented in Section 3 and illustrated in Figures 23-25A do not entirely support the applicant's conclusions. Further, since plans to accommodate these supplemental evaporative cooling schemes were neglected in selection of the site, future plans for expansion become highly dubious.

Comment: The possible effects of additional power generating facilities should also be investigated.

Response: In order to meet the demands for electrical power in the future, Public Service Company of New Hampshire is considering five sites including an additional unit at Newington. Any additional units or construction of a new generating facility will require an environmental impact statement and an operational evaluation of the Newington Station Unit No. 1 will preclude any future considerations for expansion.

Comment: A more realistic estimation of the effective flushing flow for a thermal discharge at the Newington site should be developed, possibly by a modified analysis of existing salinity, temperature and dye dispersion data, or by another continuous dye release.

Response: Following receipt of the comments by the Environmental Protection Agency, several discussions have been held between the Public Service Co. and the Environmental Protection Agency staff to develop background information supporting the company's analysis of the effective flushing rate. The details of these meetings as given by the applicant are summarized below:

a) The results of a dye study to determine tidal flushing of the estuary at the Rollins Farm site, approximately 1.2 miles upstream of the Newington site, were acceptable. This study conducted by Ebasco Services, Inc. and Webster-Martin, Inc. for Public Service Company of New Hampshire in 1968 indicated a tidal flushing rate at the Rollins Farm site of 9100 cfs. Copies of this study report were included with our original request for a Permit for Work in Navigable Waters dated November 4, 1970.

b) The tidal flushing rate in the Piscataqua River increases as one moves downstream or nearer the ocean.

c) Public Service Company of New Hampshire's assumption that all the water leaving the estuary on an ebb tide was removed by the littoral current and did not return on the flood tide was not adequately substantiated.

d) It was coincidental that the estuary-ocean interface assumed and used by Public Service Company of New Hampshire in computing flushing rates by the tidal prism method verified the results of the acceptable dye study.

e) The validity of the mathematical model developed by the company with the tidal prism method of calculations and used to compute flushing rates at locations other than the point of dye release was questioned. It was felt that conservatism was not demonstrated by assuming zero flushing in the Great Bay - Little Bay portion of the estuary.

The average summer surface heat transfer coefficient of 5 Btu/ft^2 hr $^{\circ}F$ is based upon data by Edinger and Geyer and summarized in EEI publication No. 65-902. Other calculations by the applicant based upon local meteorological data indicate a value of slightly over 6 Btu/ft^2 hr $^{\circ}F$ could be justified. The lower value was selected to be conservative.

The effective area for the surface transfer of heat has been conservatively considered as including only the mean surface area of the river and half of Little Bay. The remainder of Little Bay and all of Great Bay have not been included by the Company. This area of 271×10^6 ft^2 is conservative since (1) dye was traced over most of the estuary even at ebb slack tide and (2) if some water that leaves the estuary on the ebb returns on the flood an added effective area must exist seaward of the area originally considered.

Therefore taking the conservative tidal flushing rate of 9100 cfs as determined by dye studies as the tidal flushing rates at Newington Station and also at Schiller Station for the purposes of this application and the conservative area and transfer coefficient values mentioned above, we compute an average temperature rise in the estuary of $0.97^{\circ}F$.

(2) Department of Commerce

Comment: The statement does not provide sufficient information on the atmospheric environment.

Response: The statement has been expanded to allow for a more adequate evaluation of this aspect.

Comment: Chlorination as proposed by the applicant is an undesirable anti-fouling method and should be avoided if possible. The levels recommended by EPA are so low as to be of borderline effectiveness, if not complete ineffectiveness, for controlling fouling organisms.

Response: The discussion on anti-fouling methods has been enlarged and Public Service Co. has been made aware that an alternate control method may be made mandatory should any adverse effect occur as a result of the proposed use of chlorine.

Comment: The idea of increasing water velocities to the point where settlement cannot occur may not be practical for such a large circulating system. Likewise the utilization of fresh water to kill fouling organisms would be ineffective.

Response: The creation of shear flows in cooling water systems have been employed successfully as a fouling control method in some generating plants in England. The use of fresh water has also been proved successful but because of required shut-down time, the availability and quantity of fresh water and ultimate cost, this method is considered impractical. Also, many of the hard fouling forms (barnacles and mussles) once attached are able to withstand relatively long periods low salinity.

Comment: The only coatings on the inside of the system that are effective in reducing fouling are those that degrade slowly, releasing toxic substances into the surrounding water.

Response: It is reported that this method using copper has been somewhat successful at the Schiller Station. Measurable quantities of toxic copper, according to the applicant, have not been discernable in the discharge water. There are however various other methods which do not require use of toxic substances and which have proved successful in reducing or controlling fouling. Some of these methods have been listed in Section 5 of this statement.

Comment: Emphasis should be placed on more specific in-depth studies rather than general ecological survey-type studies.

Response: This point was brought out in the draft statement and is re-emphasized in the present impact statement.

(3) Department of Interior

Comment: The final statement should list any historical or archeological sites which may be affected and evaluate the possible impacts and mitigation measures to these sites.

Response: To the best of our knowledge neither properties listed in the National Register of Historic Places nor properties under consideration for nomination to the National Register are affected by Newington Station Unit #1. Likewise, no archeological resources are known to exist on the project site. (See letter 29 August 1972 from Maine Historic Preservation Commission).

Comment: Variations in plant operation could cause significant temperature fluctuation in the Piscataqua River, particularly in the vicinity of the plant discharge when there exists the possibility of fish being attracted to the warmer water.

Response: As this point has been raised by other agencies, a detailed discussion of this aspect has been submitted by applicant and is as follows:

The Newington Station is expected to operate as a cycling station over most of its life. However, in the early years, that is, prior to the installation of new base load generation which Public Service Company of New Hampshire anticipates placing in service in 1979, the Newington Station will be operating similar to a base load station. When the station is on cycling duty it would undoubtedly be shut down each night and returned to service each morning; and shut down each weekend and returned to service on Monday morning. On an overnight shutdown, it takes approximately one and one-half hours to bring the plant from low load to full load. On a weekend shutdown it would require somewhat in excess of two hours to bring it from low load to full load. The temperature rise through the condenser is designed to be 20°F when operating at full load. Since the circulating pumps would be operating prior to the plant coming on the line at full load, the temperature rise through the condenser on partial load would be in direct relation to the relationship between the amount of load and full load. In other words, at 50 percent load the rise through the condenser would be 10°F. The quantity of water in the estuary is considered to be basically constant. As the discharged water leaves the discharge canal and enters the river it immediately starts to mix with the water in the estuary. Since the amount of heat that is released to the river on partial load is much less and the receiving water is the same, the reduction in temperature by mixing is assumed to be greater. If this is so the action would result in a somewhat stable and gradual increase in the temperature of the receiving water as the load is increased. It is not believed therefore that there would be rapid changes in temperatures in the estuary because of the cycling duty of the station.

The far field rise in the ambient water temperature of the estuary when the station is base loaded is estimated to be 0.97°F after several tidal cycles. The load cycling nature of the plant would serve to prevent or delay the temperature rise from achieving this 0.97°F. That rate of ambient water temperature change outside the mixing zone is given by the ratio of the anticipated equilibrium estuary temperature rise to the time necessary to achieve this rise. This rate of change (either increase or decrease) is calculated to be 0.97°F/time constant of 197 hours = 0.005°F/hour. Some water quality criteria suggest a rate of change of temperature of up to 1°F/ hour as being acceptable.

Comment: It is stated, on page 5, that washings from the screens are to return to the estuary. The Department recommends that debris, dead fish and other accumulations not be returned to the estuary but be disposed of as non-contaminated solid waste.

Response: Preliminary entrapment studies (Shiller Station) have indicated that the majority of the material washed from the intake screens is rich in living plant and animal life and should be returned to the estuary. Debris such as plastic bottles will be collected and placed in barrels for periodic disposal by a contract rubbish service.

Comment: The "0.005 grain/ACFM" on page 7 should read "0.005 grain /ACF."

Response: The industry uses the abbreviation ACFM to stand for Actual Cubic Foot Measure. It is possible that the M was mistaken to be an abbreviation for Minute, which is not the case.

Comment: Dye studies by Webster-Martin, Inc. indicated that only two days were required to replace all water in the area of the plant. The Department questions such a rapid flushing and recommends that the magnitude and variation of freshwater inflows be included.

Response: Public Service Co. informs us that dye studies conducted by Webster-Martin indicate a flushing rate of 9100 cfs at the Rollins Farm Site on the Piscataqua River in September of 1968. Ebasco Services, Inc. prepared the report of these dye studies and to check the order of magnitude of the renewal rate indicated by the dye study made a standard Ketchum flushing calculation. For the section opposite the Rollins Farm Site (Newington area) it was calculated to require 46.4 hours to replace all the water in the section.

Large flow rates in the estuary are due mainly to the volume of the tidal prisms of Great and Little Bays. The fresh water in-flow to the Piscataqua estuary is, in the opinion of the applicant, insignificant compared to the tidal flows.

Comment: Temperature measurement should be made during the cold months of January, February and March.

Response: Public Service Company of New Hampshire indicates that continuous temperature monitoring throughout the entire year will be conducted at three stations, one above, one below and one in the immediate vicinity of the Newington Station. The Corps will require additional stations to be monitored in the proposed intake/discharge, discharge plume and mixing zone.

Comment: The Department recommends that the applicant consider measures of alleviating the thermal barrier to be created by this project, including modification of the discharge structures or reduction of power output during critical periods. The possible effects of additional units should also be considered.

Response: The discussion of thermal addition has been expanded to include all the above points. The Corps will require a continuous temperature monitoring transect of the "narrows" at Boiling Rock.

Comment: A discussion of the environmental impacts of filling a portion of the Piscataqua River should be given.

Response: A brief discussion of the dredging and filling aspects is included in the statement and represents the only positive and predictable consequences at this time.

Comment: The Department feels that intake velocities should be limited to a maximum of 0.5 ft sec in order to control the impingement of organisms to an acceptable level.

Response: The Corps intends to make this a condition requirement should any adverse effects occur from the currently proposed intake velocities.

Comment: The statement should discuss alternative cooling systems and alternative modification to the proposed once-through system and their environmental impacts.

Response: The section on alternatives has been expanded to include the above aspects.

(4) Bureau of Sport Fisheries & Wildlife

Comment: More detailed information on the amount of water used in the circulating system, hydrology of the Piscataqua River estuary, intake velocities should be provided in the statement.

Response: The discussions of the above points have been enlarged to include additional data.

Comment: The Bureau does not feel that the proposed intake structure design provides any more environmental safeguards than other structures, as is implied in the last paragraph on page 59.

Response: We concur that the coarse racks are not intended to exclude large fish, but are instead designed to prevent the passage of large pieces of flotsam into the intake and possibly damaging the traveling screens. Details of the safeguards that are designed into the Newington intake structure are discussed in the text.

Comment: There is no indication that temperature measurements were taken during January, February and March. The possibility of fish being attracted to the warmer water in the discharge area and other ramifications must not be overlooked.

Response: Continuous temperature monitoring throughout the entire year will be conducted at three stations located above, below and in the immediate vicinity of the Newington Station.

Comment: A clarification concerning Federal standards regarding zone of passage is needed.

Response: The discussion of this point has been expanded to present a better understanding.

Comment: The Bureau is in agreement with the EPA maximum concentration of 0.1 ppm of residual chlorine in the discharge water. Concentrations less than this have been found toxic to rainbow trout in Michigan.

Response: This point is brought out in the statement.

Comment: The section on alternatives should be enlarged to include a discussion of the possible utilization of other cooling water systems that exist, such as submerged discharge, cooling tower, and spray ponds.

Response: The discussion on alternatives has been expanded to include a discussion of these points.

(5) U.S. Coast Guard

Comment: The project will not have any effects on the Coast Guard's roles and missions.

(6) N.H. Office State Planning

Comment: The statement should further address the question of effects on organisms in those parts of the Piscataqua River which will experience considerably greater temperature increases because of their proximity to the outfall.

Response: The discharge canal is designed to release water to the surface of the estuary, but it can be modified to provide a subaqueous discharge, if it appears that this would lessen the impact on organisms.

Comment: More attention should be given to rates of temperature fluctuation.

Response: It is not believed that there would be rapid changes in temperature in the estuary. A detailed discussion of this point has been incorporated into the statement.

Comment: The applicant's concern for thermal effects on biota other than migrating fishes appears to be exclusively limited to lethal effects.

Response: The effects of sub-lethal temperatures on species diversity, growth rates and community composition will receive attention in the revised Ecological Monitoring Program. Growth studies are being conducted on the american oyster and population indices and migration patterns are being developed for lobsters and crabs.

Comment: More information on atmospheric and air quality considerations is needed.

Response: An air quality study which addresses itself to these questions is available and has been used in the development of this statement.

(7) N.H. Fish & Game

Comment: The most critical temperature problems may occur at the narrows just below Schiller Station, where it is possible that the heated effluent may create a block to migratory fish. Temperature profiles should be taken at this point in addition to the other profiles proposed.

Response: Normandeau Associates, Inc., the consulting firm contracted by the applicant, has been instructed to include this station in the river for recording temperature profile data.

Comment: In order to better determine the percentage of eggs, larvae and juvenile fish that may be endangered from entrainment and entrapment, studies in the immediate vicinity of the intake and across the channel should be intensified.

Response: The fish sampling phase of the applicant's Piscataqua River ecological studies program has been expanded to include two capture methods in this area, namely seining for adult fish and towers for fish eggs and larvae. The sonic tagging program has also been increased.

Comment: The conclusions at the bottom of page 83 and the top of page 84 are not justifiable based on data presented in the report. Additional studies must be conducted before such conclusions can be drawn.

Response: Concur. The overall lack of ecological and hydrological information for the estuary systems in question has severely hindered a realistic appraisal of construction operation effects.

(8) N.H. Water Supply and Pollution Control Commission

Comment: On pages 8 and 77-78, no maximum decibel level is stated.

Response: Attention is being given in the design to reduction of noise levels from principal items of equipment which constitute major sources of sound energy. The building enclosures are treated with acoustically absorptive material to further reduce off-site noise levels. After initial plant operation, measurement of community noise levels will be made to verify whether there is a potential for community annoyance, and if so, further corrective action will be taken to reduce the noise impact to acceptable levels.

Comment: There is no way the domestic sewage from the proposed plant may be picked up by the City of Portsmouth or Pease Air Force Base, rather than be treated on site.

Response: The nearest sewage facilities are located at Pease Air Force Base some 1½ miles distance from Newington Station. These facilities are totally committed to the Base. The Portsmouth City Council denied a request by PSNH to connect into the City sewage facilities.

(9) N.H. Air Pollution Control Commission

Comment: Since the FAA has placed a limitation on the stack height of this installation and because of its proximity to Pease Air Force Base, there has been no reference made to any possible visibility effects in this area and implications that may arise to aircraft travel.

Response: The applicant has received permission from the FAA to construct the concrete chimney as outlined in the draft Environmental Statement, and will comply with the FAA requirements for marking obstructions to air navigation.

(10) State of N.H. Public Utilities Commission

Comment: The Newington Generating Station is vitally necessary to meet the load forecast at the time of the station's projected completion.

(11) N.E. River Basins Commission

Comment: There should be some consideration of the environmental effects of the stack on the operations of the Pease Air Force Base and safety hazards involved.

Response: The FAA conducted an aeronautical study and found the chimney would not exceed any standard of Part 77 CFR nor would it be a hazard to air navigation.

Comment: The environmental effects of additional units at Newington should be evaluated, otherwise design precedents could be set which could preclude optimum protection of environmental values affected by additional units. Likewise the possibility of additional units at the Schiller and Rollins Farm site should also be assessed as they will affect the same waterway and estuary.

Response: Any future installation at any site will be designed to comply with regulations in effect at the time the installations are scheduled.

(12) New England Energy Policy Staff

Comment: The discussion of thermal effects is based on the worst possible conditions. Reference should be made to what conditions might be expected under planned operating patterns.

Response: The discussion of this point has been expanded to include this consideration.

Comment: Care should be taken to screen the plant and the switchyards from Dover Point Road, Woodbury Avenue, and Spaulding Turnpike with attractive trees and shrubs, not trash growth that could result from natural succession.

Response: Public Service Company of New Hampshire has indicated that measures will be taken to screen the station and its appurtenances with attractive plantings when construction activities are completed.

Comment: In section 1cb, page 4, it states the washings from the screens will be returned to the estuary. It would seem prudent to screen out any floating debris for proper disposal ashore.

Response: Flotsam and other trash will be removed from the screens and disposed of in an appropriate manner.

Comment: In section 2, page 11, there is mention of a slow reestablishment of the eel grass after a 40-year absence. Can the effects of increased temperature on this process be foretold?

Response: Since eel grass is more abundant in the warmer water of Great Bay than in the adjacent littoral oceanic regions, it may be speculated that any slight increase in water temperature could serve to enhance the reestablishment of it in the Great Bay complex.

Comment: The consequences of increased fuel handling and delivery should be thoroughly assessed as it is an integral part of the total operation of the facility.

Response: A brief description of the planned fuel oil facility for Newington Station Unit #1 follows:

Newington Station Unit #1 is being designed to burn either crude or #6 residual oil and the receiving and bulk storage facilities are being designed to properly handle both fuels.

Oil will be received from ocean going tankers at the existing Schiller Station Wharf, pumped to a new bulk storage tank farm and then transferred to a "day" tank at the plant site or directly to the plant for consumption.

The location of the wharf, connecting pipeline, bulk oil storage facilities and the plant are shown on an attached sketch.

The bulk storage site is just westerly of Schiller Station occupying the area that was previously C.H. Sprague & Son Company bulk material (salt and pumice) storage facility. Their bulk material operation has been terminated in order to accommodate our oil storage tanks.

These oil storage tanks do not constitute a new use of the area. Presently there are petroleum storage tanks of the Mobil Oil Company, C.H. Sprague & Son Company and other tanks of Public Service Company of New Hampshire in the immediate vicinity.

Ships expected to service Newington Station are about 650 feet long and have a capacity of 250,000 barrels. They will be connected by flexible means through a manifold to a pipe of approximately 20 inches in diameter. This pipe will be supported by an existing coal conveyor from the wharf over and to a point westerly of the Boston and Maine Railroad tracks. Thence it will drop to and continue above ground on piers to new bulk storage tanks. The ship's pumps will pump the oil up to the tanks. The tanks will be two 280,000 barrel capacity tanks contained within an earth dike, and will have a foam fire extinguishing system. These bulk tanks will gravity feed to a pump house outside the perimeter of the dike and the oil will then be pumped in an above ground pipeline, with the exception of subsurface road crossings, into the day tank. The day tank, which has a 10,000 barrel capacity, will also be within an earth dike near the plant. The fuel oil is then pumped into the plant for consumption. A No.2 fuel oil tank and a magnesium oxide additive tank are also contained within this dike. These two tanks are truck filled at the site.

The entire oil handling facility will be designed in accordance with, but not limited to, the Occupational Safety and Health Act and National Fire Protection Association and U. S. Coast Guard regulations.

The existing Schiller Station Wharf is being modified to comply with the presently proposed U. S. Coast Guard regulations on Pollution Prevention for Vessels and Oil Transfer Facilities (33 CFR Parts 154, 155 and 156). These modifications will include lighting, communications, handling equipment and small discharge containment facilities.

C. H. Sprague & Son Company will operate the fuel unloading storage and handling facility as a contractor to Public Service Company of New Hampshire and will apply for and operate under the conditions of an Oil Transfer Permit which must be obtained from the "Captain of the Port" U. S. Coast Guard. Also the New Hampshire Water Supply and Pollution Control Commission pursuant to Chapter 146-A (effective 7/1/71) has primary jurisdiction over oil spillage in public waters of the State and Public Service Company of New Hampshire and C. H. Sprague & Son Company will comply with their rules and regulations in operating this facility. The contingency plan of the Portsmouth Harbor Oil Spill Committee, of which C. H. Sprague & Son Company is a member, will also be followed.

Other applicable laws or regulations that the Portsmouth Harbor Oil Spill Committee contingency plan incorporates include:

RSA 107:8-a	Peevention of Coastal Contamination
RSA 271-A	N. H. State Port Authority
RSA 211:71-74	Damage to Fish, Other Aquatic Life, Wildlife or Their Habitat

National Oil and Hazardous Substances Pollution Contingency Plan Annex X

The State of Maine and New Hampshire have the authority through the New England Interstate Water Pollution Commission to establish regulations for this waterway. At the present time no joint regulations have been established as to controls pertaining to the handling of oil.

Ships, larger than the size we contemplate berthing, have navigated this river in the psst. New Hampshire RSA Chapter 271-A requires all vessels over 150 tons, except fishing vessels and pleasure craft, be piloted by an authorized pilot both in and out of the harbor. The Harbor Pilot's general practice is to utilize tugboats and to bring fully loaded vessels up the river at the end of the flood tide to berth at flood slack, and to leave the berth shortly before the flood slack or somewhat after the ebb slack to assure a river current opposite the direction of the departing vessel. This has been done safely, successfully and without incident for many years.

Presently approximately 35 ocean going tankers per year arrive and depart this existing wharf and we anticipate an additional 24 tankers per year to supply Newington Unit #1. We feel that the oil handling facilities for Newington Station Unit #1 will provide safe and environmentally sound means for supplying this station with fuel.

Public Service Company of N.H. has neglected to mention or provide any information regarding preventive measures or an oil spill contingency plan.

The Corps therefore has written three requirements into the permit conditions prefacing this report.

(13) Normandeau Associates, Inc.

Normandeau Associates provided additional information on their research investigations which has been incorporated into the statement. A meeting was held during late May between Public Service Co., Normandeau Associates, N.H. Fish and Game Dept. and the Corps to discuss shortcomings of the current monitoring program and to outline future input requirements.

(14) Jackson & Moreland

Comment: On page 54, we are unable to verify the paragraph which states:

> "At the edge of the mixing zone the temperature of the water at any depth shall not exceed 82°F at any time. The temperature of the bottom waters at the edge of the mixing zone shall not exceed 77°F for more than an aggregate of 8 hours for any 24 hour period and shall not exceed 79°F at any time".

Response: The paragraph represents a recommended condition issued by EPA for coastal power generating facilities. It should be obvious that such conditions be flexible and depend on the ambient temperatures characterizing a particular water body. See EPA letter of comment for further clarification.

(15) Public Service Co. N.H.

The Public Service Co. of N.H., as the applicant for construction and discharge permits for Newington Station Unit #1, and in accordance with OCE guidelines on coordination of environmental statements, is included in the review process. Comments received from the Public Service Co. regarding the draft statement were primarily editorial in nature with subsequent corrections being carried over in the preparation of this final statement.

Other comments made by Public Service Co. were:

<u>Comment</u>: It is our understanding that a sentence must be included indicating that the National Register of Historic Places has been consulted and that no National Register properties will be affected by the project. No such sentence is presently included.

<u>Response</u>: The Corps feels that it is the responsibility of the applicant to supply evidence of coordination with the National Register as well as the State agencies on this aspect. This was not done and the Corps requested such information be made available for inclusion in the final statement. The Department of Interior, while not affording any positive information itself, has indicated we appropriate State agencies to contact.

<u>Comment</u>: We suggest your statement covering the possibility of a thermal blockage should mention that the analytical predictions of plume extent show this will not occur.

<u>Response</u>: On the contrary, the studies on the proposed surface discharge for Newington Station as illustrated in figures 24A and 25A show that the plume may well create a thermal block on ebbing and at slack tide stages. The N.H. Fish and Game Department, EPA, and other reviewing agencies are in agreement with the Corps on interpretation of these data. As a matter of record, the exact wording (p.11 Conclusions, Environmental Statement Feb. 1971) by PSNH reads "no thermal blockage.... is expected ..." and not positively that it will not occur.

<u>Comment</u>: We desire an opportunity to review and comment on any additions to the monitoring programs before these are incorporated into the final statement and become conditions of any permits.

Response: The Corps will continue its coordination practice on this aspect. The Corps' position on the inadequacies of the present monitoring program is thought to be clearly stated in the draft statement. Further recommendations for input were reiterated at the May meeting with the N.H. Fish and Game Department and Normandeau Associates.

Comment: Public Service, N.H. believes that experience with continuous low residual chlorination at Schiller Station is more germane to any environmental impact and biofouling problems than reference (by Corps) to the Cape Canal Station.

Response: The Corps has stated its uncertainty about the extrapolation of such data to the Newington Station. Several other reports in addition to the Canal studies exist which substantiate the actual and potential adverse effects of the chlorination method.

Comment: Public Service, N.H. does not think that the assumptions stated in par. 2, pg. 87 are valid nor merit more refined studies prior to the issuance of the requested permits. Positive predictions have been made by the Applicant and his consultant.

Response: The Corps strongly feels that the ecological and environmental data collected and analyzed to date does not support these predictions. The predictions are actual value judgements made by the consultant and are open to conjecture. The only information made available to the Corps and on which its evaluations were formulated was contained in the Environmental Impact Statement, Newington Station Unit #1, February 1971 prepared by Public Service Co. of N.H. and Report No. 1 on the Piscataqua River Ecology Study 1970 Monitoring Studies by Normandeau Associates.

UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY
John F. Kennedy Federal Building - Room 2303
Boston, Massachusetts 02203

June 30, 1972

Mr. John William Leslie
Chief, Engineering Division
Corps of Engineers
New England Division
424 Trapelo Road
Waltham, Massachusetts 02154

Dear Mr. Leslie:

We have reviewed the environmental impact statement for Newington Power Station in Newington, New Hampshire. We recommend that the State of Maine be notified that the quality of its waters will be adversely affected by this project. We also recommend

1. That the survey nature of the ecological investigations be expanded before completion of the facility to provide more information needed to assess the environmental impact.

2. That alternatives to this project be investigated, including alternative discharge or cooling methods, and alternative methods for condenser cleaning.

3. That the possible effects of additional power generating facilities (as reported elsewhere by the applicant[1]) also be investigated.

4. That the applicant develop a more realistic estimation of the effective flushing flow for a thermal discharge at the Newington site, possibly by a modified analysis of existing salinity, temperature and dye dispersion data, or by another continuous dye release.

Our comments in summary are that this valuable area will be adversely affected and that the heated discharge might not meet standards according to our calculation. We also noted specific adverse biological effects. Our detailed comments follow.

Sincerely yours,

Joan Hirrwan
for Bartlett Hague
Chief, Environmental Impact Branch

1. Public Service Company of New Hampshire "Planning for the Year 2000," 1970.

DETAILED COMMENTS

Page 91 lists alternatives that were proposed for the plant location and the best type plant to meet the power needs in New Hampshire. It is unfortunate that the NEPA review procedures were not in effect in 1966. If this draft statement could have been reviewed before this plant was under construction, maybe a more suitable location could have been chosen.

The Piscataqua River and its associated bays and tidal streams form an extensive interstate estuarine system within the States of Maine and New Hampshire. The river is noted to support diverse recreational and commercial fisheries, including a recently introduced species, the coho salmon. Considerable commercial shellfishing activities are also reported to take place within the estuary chosen. As indicated in the statement on pages 25-50, this area has a large marine population that could be affected by a thermal change. This area is also one of the few areas used for natural research on environmental surroundings. Locating of the power plant at this site could create a serious effect upon the local organisms and the research projects now in progress.

Judging from the hydrography and geography of the area, it is likely (if not certain) that the construction and operation of the Newington station would affect the water quality of both states. Under Section 21(B)2 of the Federal Water Pollution Control Act (as amended), it is therefore necessary for the EPA Administrator to notify the State of Maine that the quality of its waters may be affected by this power plant.

THERMAL MODELING

In the Environmental Statement it is reported that the ultimate average temperature rise in the estuary resulting from operation of both Schiller and Newington stations would be 0.67°F. Similarly, the maximum long-term peak temperature rise would be 0.94°F, considering both advection and surface heat loss, while considering heat removal only through advection, the peak increase in temperature would be 1.25°F. It appears that these figures are based on a tidal flushing rate as calculated in the Jackson & Moreland Report of 22 May 1970, where $Q_F = (P_T - V_L)/12.4$ hrs.

and Q_F = flushing flow

P_T = tidal prism flowing past Newington

V_L = low tide volume of estuary below Newington.

We believe that this is not a reasonable method to make this calculation, and that the dye flushing rate as measured for the Rollins Farm site is a much more realistic figure (9000 cfs).

We have made an independent calculation for the flushing rate of the Piscataqua River estuary using the method of Bowden (1967). Although this method provides the flushing rate for a contaminant introduced into the estuary in a manner similar to the river flow, it can be used as a lower limit for this flushing parameter. The calculated value is 5930 cfs (see attachment 1).

Using a simple heat balance model along with the values for surface heat loss coefficient and effective water surface which are given by the applicant, the average summer temperature rise in the estuary has been calculated to be 1.28°F, assuming a flushing flow of 9000 cfs, and 1.73°F, assuming a flushing flow of 6000 cfs. It is felt, however, that the surface heat loss coefficient provided by the applicant may be overly conservative, and therefore these average summer temperature increases were predicted to be 1.05°F and 1.34°F, respectively, using a less restrictive coefficient value. The method and calculations are given in attachment 2.

COMPLIANCE WITH REGULATIONS

As mentioned in the statement, the applicable water quality standards (including New Hampshire, Maine and the Federal recommendations) allow for a temperature increase of 1.5°F during the summer months outside of a mixing zone. It is quite clear from the attached predictions that the proposed thermal discharge may not comply with these temperature standards with a reasonable sized mixing zone. It is also reported in the statement that the "Federal Standards" for estuarine waters would allow (at the edge of a mixing zone) a maximum water temperature of :82°F at any depth, any time; 77°F at the bottom for any 8 hours in a 24 hour period; and 79°F at the bottom any time. These are not actually standards as such, but were established as permit conditions for a specific heated effluent. While these criteria may be useful as guidelines for the Newington site, specific conditions will have to be developed for this discharge based on the biology and geography of the Piscatuqua River estuary.

BIOLOGICAL EFFECTS

We are particularly concerned about the possible effects of entrainment upon meroplanktonic organisms indigenous to the estuary. This is especially true because of the relatively poor flushing characteristic of this water body. Some data has been provided by the applicant relative to the seasonal and tidal distributions of plankton. However, this information is too limited to illustrate such patterns. We would like to see, for example, if there is any tendency for plankters to resist tidal flushing (higher concentrations at low water), or to congregate near the western shoreline. Although the proposed entrainment studies should provide some important data, it is essential that this kind of information be available during preliminary steps in order to evaluate a priori the environmental effects. A close examination of the literature on thermal effects would be helpful; however, a certain amount of new information must typically be developed by the applicant. Based on reported laboratory and field observations, it can be expected that both Eurytemora hermani and Arcatia clausi will be at a competitive disadvantage during the summer in the estuary.[2, 3] Their abundance would certainly be reduced during the warmer months.

The field data on fish entrapment at the Schiller Station indicate that this problem is of minimal significance at this plant. We agree with the Corps that this data cannot readily be extrapolated to the potential situation at the Newington Station. The only way in which the severity of this problem can be predicted is by developing a better understanding of the finfish habits and life histories in this estuary. Even though such information has not yet been provided, the pending ecological investigations should be directed toward answering some pertinent questions such as: the frequency and size of migrations past the site; the susceptibility of these organisms to power plant intake flows; the proximity of spawning areas to the site; any tendencies for species to congregate near the intake.

Serious considerations should be given to alternate techniques for control of biological fouling. Although controlled use of chlorine for such purposes has previously been accepted, the EPA is now recommending the use of physical methods or species-specific chemicals wherever possible. This policy is based on numerous reports of chlorine-caused fish-kills resulting from operational failures, as well as laboratory investigations indicating that chlorination practices can result in formation of highly persistent and toxic chlorinated organic compounds. In any event, the maximum acceptable concentration of total residual chlorine should be 0.10 ppm.

2. Gonzales, J. 1972. PhD. Thesis, University of Rhode Island (unpublished)

3. Katona, S. 1970. Growth characteristics of the copepod Eurythemora hermani in laboratory cultures. Helgolander wies. Meeresunters. 20: 273-384.

Di 7920

July 21, 1972

ENCLOSED: Attachments to comments (June 8, 1972) on Newington Power Station -- Newington, New Hampshire

Joan Harrison
Environmental Impact Coordinator
Environmental Protection Agency
John F. Kennedy Federal Building
Room 2303
Boston, Massachusetts 02203
(617)-223-4635

ATTACHMENT 1.

Bowden (1967)[1] has reported a simple salt-balance method for estimating the time required to flush a contaminant from an estuary. This method is limited by the fact that the contaminant must be introduced to the estuary in a manner similar to the river flow. It can be used, however, in many situations as a conservative estimate for estuarial flushing rate.

$$f = (S_o - S) / S_o$$

$$F = \int_{vol}^{o} f d (vol)$$

$$t = F/R$$

S_o = ocean salinity (assumed 30 ppt.)

S = salinity in volumetric segment

R = river flow (assumed 300 cfs during summer)

t = time to flush a contaminant from an estuary

$$Q_f = \frac{V}{t}$$

Q_f = flushing flow

V = mean volume of estuary to be flushed

1. BOWDEN, K. F. 1967, Circulation and diffusion in Lauff, G. H. (ed) Estuaries. AAAS Publ. No. 83, Washington, D. C.

Salt Balance for Piscataqua River Estuary

Segment number*	Volume (V) (cu. ft.)	Salinity (ppt) Sampling Stations**	Mean Value	$\frac{S_o - S}{S_o}$	$V \times \frac{S_o - S}{S_o}$
1 & 2	1.478×10^9	1, 2 & 3	29.0	3.33×10^{-2}	4.93×10^7
5	0.696×10^9	3 & 4	28.8	4.0×10^{-2}	2.78
6A & B	0.293×10^9	4 & 5	28.6	4.65×10^{-2}	1.36
7 & 10	1.085×10^9	5, 6 & 2B	28.4	5.32×10^{-2}	5.77
12	0.670×10^9	2B & 3B	28.0	6.65×10^{-2}	4.46
14 & 17	0.583×10^9	4B & (1/2)3B	27.4	8.65×10^{-2}	5.04
TOTALS	4.805×10^9				24.34×10^7

$$F = \sum_{o}^{vol} \left(\frac{S_o - S}{S_o}\right) \times V = 2.434 \times 10^8 \text{ ft}^3$$

$$t = \frac{2.434 \times 10^8 \text{ ft}^3}{.3 \times 10^3 \text{ ft}^3/\text{sec}} = \frac{8.1 \times 10^5 \text{ sec}}{3600 \frac{\text{sec}}{\text{hr}} \times 24 \frac{\text{hr}}{\text{day}}}$$

$$= 9.4 \text{ days}$$

$$Q_F = \frac{4.8 \times 10^9 \text{ ft}^3}{8.1 \times 10^3 \text{ ft}^3/\text{sec}} = 5930 \text{ cfs}$$

* Jackson & Moreland. Report in Support of Application for Water Use Permit, Piscataqua River at Newington. Revision No. 1, May 22, 1970

** Normandeau Associates. Piscataqua River Study, Appendix 2. PSCNH November 1969.

ATTACHMENT 2.

A. ΔT_F = avg. temperature increase = $\dfrac{\sum \Delta T_p\, Q_p}{Q_F + kA_F}$

ΔT_p = power plant temp. rise (20 & 19.2) ^{o}F

Q_p = power plant circ. water flow (500 & 250)cfs

Q_F = flushing flow =(6300 & 9300) cfs

k = surface heat loss coefficient = 1.33×10^{-5} fps

A_F = effective surface area = 1.7×10^{8} ft^2

(1) $$\Delta T_F = \frac{20(500) + 19.2(250)}{9300 + (1.7 \times 10^{8})\, 1.33 \times 10^{-5}}$$

$$= 1.28\ ^{o}F$$

$$\Delta T_F^{*} = \frac{20(500) + 19.2(250)}{6300 + (1.7 \times 10^{8})\, 1.33 \times 10^{-5}}$$

$$= 1.73\ ^{o}F$$

B. $\Delta T_{p_1} = 20\ ^oF$ $\qquad\qquad$ $\Delta T_{p_2} = 19.2\ ^oF$

$QQ_{p_1} = 500$ cfs $\qquad\qquad$ $QQ_{p_2} = 250$ cfs

$A_F = 1.7 \times 10^8\ ft^2$

$Q_{F_o} = Q_T + R$

$Q_{F_o} = 9000 + 300 = 9300$ (from dye release data)

$Q^*_{F_o} = 6000 + 300 = 6300$ (from Bowden, 1967)

$k = 2.8 \times 10^{-5}$ fps

$$\Delta T_F = \frac{T_P\, Q_p}{Q_F + K_F}$$

(1) $$\Delta T_F = \frac{20(500) + 19.2(250)}{9300 + (1.7 \times 10^8)\ 2.8 \times 10^{-5}}\ ^oF$$

$$= \frac{10,000 + 4800}{14,060} = 1.05^{0\,o}F$$

(2) $$\Delta T_F^* = \frac{14,800}{6300 + 5100} = 1.34\ ^oF$$

United States Department of the Interior

OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

ER 72/488

JUL 26 1972

Dear Mr. Leslie:

This is in response to your letter of April 21, 1972, requesting our comments on the Corps of Engineers' draft environmental statement dated March 15, 1972, on environmental considerations for Newington Generating Station Unit No. 1, Rockingham County, New Hampshire.

General

This Department commented on this project in response to the Corps of Engineers' public notice No. 71-110 dated November 30, 1970.

Many of the inadequacies of the applicant's predictions of environmental impacts are recognized by the Corps of Engineers on pages 84-87. We assume that these inadequacies which are pointed out will be a basis for requiring the necessary further background data to support these predictions. Our detailed comments are presented in the following paragraphs according to specific sections in the statement or according to specific subjects.

Historical Significance

The final statement should show evidence of reference to the National Register of Historic Places and should indicate if any National Register properties would be affected by the proposed project. Properties which would be affected should be identified and the nature of the effects should be analyzed. Also, the environmental statement should contain a record showing compliance with Section 106 of the National Historic Preservation Act of 1966 (80 Stat. 915) in accordance with procedures of the Advisory Council of Historic Preservation as they appear in the Federal Register, March 15, 1972. The environmental statement should also show evidence of consultation with the New Hampshire and Maine State Liaison Officers for Historic Preservation concerning historic properties under consideration for nomination to the National Register which could be affected by the proposed action. The titles and addresses of these officers are:

Commissioner, Department of Resources
and Economic Development
856 State House Annex
Concord, New Hampshire 03301

Director, State Park and
Recreation Commission
State Office Building
Augusta, Maine 04330

The final environmental statement should reveal whether or not archeological resources exist on the project site. If such resources are found on the site, the statement should contain an evaluation of their significance, assess the impact of the proposed project on them, and recommend action to mitigate any adverse effects. We suggest that consultation on this matter be held with Mr. Howard R. Sargent, Department of Anthropology, Franklin Pierce College, Rindge, New Hampshire 03461.

Planned Operation

According to information presented on page 2 the plant will normally operate only five days per week for about 16 hours per day. The occurrence of shutdowns and the accompanying effects on aquatic life should be considered in relation to plant operation as discussed in this section.

Variations in plant operation could cause significant temperature fluctuation in the Piscataqua River, particularly in the vicinity of the plant discharge when there exist the possibility of fish being attracted to the warmer water.

Cooling Water System

It is stated on page 5 that washings from the screens are to be collected in a trough and returned to the estuary. We recommend that debris, dead fish, and other accumulations not be returned to the estuary but be disposed of as non-contaminated solid waste. The procedure for disposal should be described in the final environmental statement.

Flue Gas System

The "0.005 grain/ACFM" on page 7 should read "0.005 grain/ACF."

Seasonal Temperature Variations

Dye studies by Webster-Martin, Inc. indicated that only two days were required to replace all water in the area of the plant. Such a rapid flushing of a tidal estuary is most unusual even in the presence of large freshwater inflows and is therefore questioned. In order to give additional basis for such a conclusion the magnitude and variation of freshwater inflows should also be included.

Temperature Profiles

Temperature measurements were not made during the months of January, February, and March. We feel that environmental studies should also include measurements during these cold months of the year. Our concern for the aquatic life which will be affected by this plant is primarily during the cold season due to the planned operation of the plant.

Thermal Addition

As pointed out by both the applicant and the Corps of Engineers, the combined heat load on the Piscataqua River and estuary resulting from the operation of the proposed Newington Power Station, combined with that now being produced by the existing Schiller Station, located 0.2 miles downstream, may be excessive during certain critical periods. The applicant's analysis of the heat distribution and buildup for the new plant and for the two plants combined is reasonable; however, we have some reservations since the temperature rise for the Schiller Station was calculated rather than actually measured. It is suggested that actual temperature patterns produced by the Schiller Station be observed during a critical period and the results extrapolated to the Newington Station. If the actual water temperatures produced by the Schiller Station are too low for accurate measurement or a full-load condition is not reached and maintained for a sufficient length of time, the injection of a dye tracer into the cooling water and the measurement of the heated water-dye plume would yield data adequate to predict the thermal effects of the Newington Station as well as the combined effects of the two stations.

Figure 25 A shows that most of the water surface at section "D-D" will be affected by a temperature rise of 1.5°F. or greater during mean low water conditions. The remaining surface width which is affected by less than 1.5°F. rise is not great enough to meet the water quality criteria for zones of passage as suggested by the National Technical Advisory Committee in its report dated April 1, 1968, to the Secretary of the Interior nor does it constitute a sufficiently large enough zone to adequately provide for the free passage of fish as viewed by this Department. We strongly recommend that the applicant consider measures of alleviating the thermal barrier to be created by this project, including modification of the discharge structure or reduction of power output during critical periods. The possibility of a thermal barrier forming in the vicinity of Boiling Rock is recognized on page 86. This discussion should also relate to any additional units considered for this site.

Dredge and Fill

As illustrated on figure 26, a portion of the Piscataqua River will be filled below the mean high water line for plant installation. A discussion of the environmental impacts caused by this filling should be given.

Entrainment and Entrapment

The study of the effects of entrainment on planktonic forms mentioned on page 57 should be expanded. Sampling times and frequencies should be modified to cover both daytime and nighttime periods of the same day at various tidal cycles.

According to information on page 59, the proposed intake velocity will be limited to 0.68 to less than 1.0 fps. In general, this Department thinks that intake velocities should be limited to a maximum of 0.5 fps in order to control the impingement of organisms to an acceptable level. Evidence at Indian Point Unit 1 and other powerplants has shown that even with low intake velocities the ability of aquatic life to avoid impingement is often questionable especially when cold water temperatures are involved. A discussion of future studies to evaluate fish impingement at this site should be included in the statement as well as methods by which the intake structure might be modified to reduce or eliminate this loss.

Stack Emissions

Major air pollutants are indicated to be particulates, sulfur dioxide and nitrogen oxides. The permissible sulfur content of this fuel oil may turn out to be slightly less than 1 percent sulfur, but as a first approximation, 1 percent sulfur content seems reasonable. Nitrogen oxide formation will be minimized by reduction of excess air in the fuel-firing process and by use of tangential firing. Research has indicated that improvement in NO_x control may be obtained by using such techniques and particularly by reduced air usage. No proven reliable alternative is presently available for substantial removal of NO_x from combustion gases.

Cumulative Effects

In order to fully assess the expected cumulative environmental effects, the contemplated ultimate development of this site and other areas which may impact on this project or be impacted upon by this project should be described. In some cases the summation of individual environmental impacts of actions are less than the cumulative impacts of these same actions due to the interactions of impacts.

Alternatives to the Proposed Action

We believe that the statement should discuss alternative cooling systems and alternative modifications to the proposed once-through system. This section is incomplete without a discussion of the use of cooling towers, cooling ponds, and modification of the once-through system, along with their environmental effects.

We hope these comments will be helpful to you in the preparation of the final environmental statement.

Sincerely yours,

Deputy Assistant Secretary of the Interior

Mr. John William Leslie
Chief, Engineering Division
New England Division
Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

THE ASSISTANT SECRETARY OF COMMERCE
Washington, D.C. 20230

June 22, 1972

Mr. John M. Leslie, Chief
Engineering Division
U.S. Department of the Army,
Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

Dear Mr. Leslie:

The Department of Commerce reviewed the "Newington Generating Station, Unit Number 1, Newington, New Hampshire," draft environmental statement and forwarded our comments to you on June 7, 1972.

Since that time, additional information has been developed which is pertinent to the project. This additional information is offered for your consideration.

The Corps of Engineers itself has included criticisms and suggestions regarding the environmental studies, with which we substantially agree. We offer the following comments in order to clarify facts or interpreation regarding the control of biological fouling in condenser cooling water lines, and to correct a few critical errors that appear to be typographical.

Under The Environmental Impacts of the Proposed Action, on page 58, crustacean larvae and fish should be added to the list of plankters to be observed through the entrainment cycle.

The subject of anti-fouling measures, treated on pages 64-67, is not throughly considered. Our comments on the various alternatives presented are as follows:

(1) Chlorination is proposed by the applicant. In and of itself, this anti-fouling method is undesirable and should be avoided if possible. Moreover, the levels recommended by EPA are so low as to be of borderline effectiveness, if not complete ineffectiveness, for controlling fouling organisms.

(2) The principle of recycling cooling water to raise the temperature to a level lethal to fouling organisms seems to have been misinterpreted or not fully considered by the applicant's engineers. The proposed mode of operation calls for inoperative or low-load periods at night and on weekends. Prior to such a shut-down, the entire intake-discharge system could be sealed off, the temperatures increased to lethal limits, and the water allowed to cool before discharge into the river. If low-load or standby conditions require some cooling water, a much smaller standby pump and piping could be installed to achieve this and it might also be possible, through greated reduced flow, to increase the main system temperatures sufficiently while, because of the low flow, not affecting water temperatures outside the approved mixing zone.

(3) The discussion of intake velocities on page 66, lines 15-20, seems related not to the subject of anti-fouling measures, but rather to the previously discussed subject of entrainment. In any case, the idea of increasing water velocities to the point where settlement cannot occur may not be practical for such a large circulating system. Even in situations where this method has been possible in straight piping, any alteration in pipe configuration that causes turbulence or slowing of current flow would encourage settlement of organisms.

(4) The utilization of fresh water to kill fouling organisms would require periods of nearly a week to kill such durable forms as mussels and barnacles. This method generally has been considered ineffective in the control of these organisms by laboratories and aquariums having sea water systems.

(5) The application of epoxy or any other hard, glossy finish to the inside of the system will not eliminate fouling. The only coatings that are effective in reducing fouling are those that slowly degrade, releasing toxic substances into the surrounding water.

Regarding <u>Any Adverse Environmental Effects which Cannot be Avoided Should the Plan be Implemented</u>, the criticism and comments offered by the Corps of Engineers on pages 84-90, with regard to the predictions and conclusions given by the applicant, seem to cover the subject. We agree in general with the recommendation for more specific and in-depth studies, rather than for the general ecological survey-type of study that is sufficient only for background information. The comments by the Corps of Engineers also echo the comments submitted last year by the Bureau of Sport Fisheries and Wildlife.

On page 88, line 4, the reference to "200 plankton" probably should be altered to read "Zooplankton."

Pertinent to Coordination with other Agencies, coordination with the National Marine Fisheries Service may be obtained by contacting:

Russell T. Norris, Regional Director
Northeast Region
National Marine Fisheries Service
Federal Building
14 Elm Street
Gloucester, Massachusetts 01930

We hope these comments will be of further assistance to you in the preparation of the final statement.

Sincerely,

Sidney R. Galler

Sidney R. Galler
Deputy Assistant Secretary
for Environmental Affairs

THE ASSIST. NT SECRETARY OF COMMERCE
Washington, D.C. 20230

June 7, 1972

Mr. John M. Leslie, Chief
Engineering Division
U. S. Department of the Army
Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

Dear Mr. Leslie:

The draft environmental statement for the "Newington Generating Station Unit Number 1, Newington, New Hampshire", reference NEDED-R, which accompanied your letter of April 21, 1972, has been received by the Department of Commerce for review and comment.

The Department of Commerce has reviewed the draft environmental statement and has the following comments to offer for your consideration.

The environmental statement seems to be concerned with the impact on the biological environment and does not provide sufficient information on the atmospheric environment. The only substantive statement made with regard to atmospheric pollutants is on page 77 where it states "preliminary estimates by the applicant indicate that ground level concentrations of the contaminants emitted from the Newington Station will be well below federal and state Ambient Air Quality Standards even under adverse meteorological conditions." There is no indication that the federal government has, on a technical basis, evaluated these "preliminary estimates". The studies and estimates, which apparently have been made by the applicant, have not been made available to the reviewers. Although stack height (410 feet) and stack gas exist temperature ($510^{o}F$) are specified, no mention is made of stack gas exit velocity or expected contaminant release rate (micrograms/sec) to the atmosphere.

Finally, since no meteorological data or assumptions are made available in the draft environmental statement, we are unable, at this time, to evaluate whether the applicant's contention that air quality standards will be met is valid.

In summary, we find the air quality evaluation in the draft environmental statement to be inadequate.

We hope these comments will be of assistance to you in the preparation of the final statement.

Sincerely,

Sidney R. Galler

Sidney R. Galler
Deputy Assistant Secretary
for Environmental Affairs

DEPARTMENT OF TRANSPORTATION
UNITED STATES COAST GUARD

Address reply to:
COMMANDER (oil)
First Coast Guard District
J. F. Kennedy Federal Bldg.
Government Center
Boston, Mass. 02203
Tel: 617 223-3630

5922/15
8 MAY 1972

From: Commander, First Coast Guard District
To: Division Engineer, United States Army Corps of Engineers, New England Division

Subj: Comment on Draft Environmental Statement for Newington Generating Station Unit No. 1, Newington, New Hampshire

Ref: (a) NEDED-R of 21 April 1972

1. After a thorough review of the referenced project, we have concluded that it will have no environmental impact on the Coast Guard's roles and missions. We therefore, have no objections to this project.

W. N. Banks

W. N. BANKS
By direction

STATE OF NEW HAMPSHIRE
FISH AND GAME DEPARTMENT
34 BRIDGE STREET
CONCORD, N.H. 03301

FISH AND GAME

BERNARD W. CORSON
DIRECTOR

June 5, 1972

John Wm. Leslie
Chief Engineering Division
Department of the Army
Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

Dear Mr. Leslie:

Our staff has reviewed the environmental statement for Newington Generating Station #1, Newington, New Hampshire and have the following comments:

Basically we agree with this environmental statement. We do have a few minor comments and a few places where we would like to highlight your criticisms. These are as follows:

In the center of page 15 it is stated, "Eventually it is hoped that this fishery will be self-supporting, receiving no further hatchery-raised fish." We believe this statement to be incorrect. While we intend to take every advantage of naturally reared smolt it is our opinion that the tributary system to Great Bay is not capable of supporting a sufficient number of smolt to provide a fishery. Therefore, the hatchery product will, in our opinion, always be of importance.

We should like to elaborate a bit on the Corps comments in the last paragraph, page 53. Here it is stated that "The zone of passage, although seemingly within the guidelines of 50% of the river cross-section is near critical limits under slack tide conditions (figure 25A)." We believe this paragraph is of extreme importance, particularly in view of the fact that this plant is called Newington Generating Station Unit #1. If, in fact, this zone of passage proves to be nearing the critical limits after operation begins it would be our opinion that no further units could be added without being coupled with adequate cooling facilities.

In the first full paragraph on page 54 temperatures to be measured at the edge of the mixing zone are cited. We believe that these temperatures are not realistic for the northeast, as our waters are much colder than those found further south. In other words, it is our opinion that the important criteria is that temperature rises at the reference stations do not exceed 1.5°F during July, August, and September and 4°F during the remainder of the year.

It is our opinion that the most critical temperature problems may occur at the "narrows" just below Shiller Station, where it is possible that the heated effluent may create a block to migratory fish. We would suggest, therefore, that temperature profiles be taken at this point in addition to the other profiles proposed. It is our understanding that Public Service Company agrees to incorporate this in their future studies. One possible effect of this heated effluent could be to block the upstream migration of fish such as coho salmon and striped bass. We have requested and Public Service Company has agreed to beef up the sonic tracking of these two species. It is essential that we know the rate and route of migration of these species past the plant previous to operation. These studies must be continued in the post operational phase in order to determine the effects of the plant upon these species.

One major concern is that of entrainment and entrapment of eggs and larvae of fish. We believe the eggs and larvae of certain species such as alewives, river herring, menhaden, smelt, and silversides may be particularly susceptible to entrainment and entrapment. The fact that the power company will only be taking a small volume of the total flow through the plant may have no real bearing on the matter. It is essential that the time and route of migration of these species past the plant be determined. If, for example, large numbers were found to be migrating directly in front of the proposed intake structure it would be possible to entrain most of the recruitment in the cooling system. This could cause elimination of the species. We strongly recommend, therefore, that studies in the immediate vicinity of the intake and across the channel be intensified in order to determine the percentage of eggs, larvae, and juveniles that may be endangered from entrainment and entrapment.

We concur with the recommendation of the Environmental Protection Agency that the concentration of chemical biocides (chlorine) should not exceed 0.1 ppm at any time.

In the last full paragraph on page 83 the following statement is made: "Since natural temperature variability throughout the estuary is considerable a temperature increase of this magnitude will not have, in the applicant's judgement, any measureable affect on the biota of the estuary." We do not believe that this is a justifiable conclusion, as it has been proven many times that only slight changes in natural temperatures can cause changes in the biota.

At the top of page 84 it is stated, "Since the present discharge from the Shiller Generating Station has apparently not interfered with fish passage there should be no significant interference with migration of fish into and out of the estuary as a result of additional thermal release." We do not believe that this is a justifiable conclusion based on the data presented in the report. Additional studies must be conducted before such conclusions can be drawn.

Mr. John Wm. Leslie (continued) June 5, 1972

The following paragraph relative to entrainment is also, in our opinion, not a justifiable conclusion. This matter has been discussed in some detail previously.

We agree with the comments of the Corps that begin in the last paragraph at the bottom of page 84 and continue onto the top of page 85. It is our understanding, however, that additional reports which are not yet available will ease our minds in this matter and that the studies currently being conducted are in fact in-depth studies. If this is the case, we would recommend that any additional reports be appended to this environmental impact statement.

In the first sentence at the top of page 102 it is stated, "There might be an adverse affect..." We suggest that the word "might" be changed to "will".

Sincerely yours,

Bernard W. Corson
Director

BWC/pd

State of New Hampshire
Office of State Planning
STATE HOUSE ANNEX, CONCORD, N.H. 03301
MARY LOUISE HANCOCK
PLANNING DIRECTOR

June 12, 1972

Mr. John Wm. Leslie
Chief, Engineering Division
U.S. Army Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

RE: NEDED-R

Dear Mr. Leslie:

My staff has reviewed the draft environmental statement for Newington Generating Station, Unit No. 1, Newington, New Hampshire, prepared for Public Service Company of New Hampshire.

We thoroughly concur with the Corps' skepticism (pp. 84-88) of the applicant's predictions of minimal adverse effects. The studies done to date clearly do not support the claims made by the applicant in Section 4, "Adverse Environmental Effects Which Cannot Be Avoided Should the Proposal be Implemented."

We have reservations about a number of items beyond those delineated by the Corps.

First, the applicant forecasts no measureable effect on biota as a result of the temperature rise of the estuary. Although it is desirable to look for potential effects in the entire Great Bay and Little Bay complex, it is not sufficient. The temperature of the entire estuary may well be raised less than 1^{o}F. That, however, does not address the question of effects on organisms in those parts of the Piscataqua River which will experience considerably greater temperature increases because of their proximity to the outfall.

Although the temperature prediction studies indicate that even at slack tide the plant will conform to New England Interstate Water Pollution Control Commission standards, this is no assurance that there will not be interference with fish migration. Standards are manmade and hence imperfect. They should not be used as substitutes for adequate research findings.

Very little attention is given to rates of temperature fluctuation. Since Newington is designed to be a cycling plant, rapid changes in temperature are apt to be the rule rather than the exception. In spite of this, the applicant's predictions assume base load operating characteristics.

The applicant's concern for thermal effects on biota other than migrating fishes appears to be exclusively limited to lethal effects. These are not the only thermal effects, nor, in fact, are they necessarily the most important. Since many significant effects occur at sub-lethal temperatures, we are disturbed that the applicant has ignored them.

Although the proposed intake velocity of 0.68 fps. to less than 1.0 fps is sufficiently low to allow some organisms to avoid entrainment, it is still high compared to the 0.5 to 0.75 fps recommended by the Bureau of Sport Fisheries and Wildlife.

The narrow distribution which characterizes nearly 60% of the subtidal benthos sampled warrants more careful consideration than it is given here. Species diversity is a valuable measure of the condition of an ecosystem, and the maintenance of a high level of diversity should be sought.

Finally, although the interests of the Corps in this proposal are water oriented, an environmental impact statement should not be limited to the concerns of the proposing agency. The brief section which deals with stack emissions is altogether lacking in detail. What meterological conditions prevail? What quantities of particulates, SO_x, and NO_x will be emitted? What is the design efficiency of the precipitators? What are the potential health and aesthetic effects of the sub-micron particulates which the precipitators cannot remove? None of these questions is raised here, much less answered. Yet they are questions which deserve a broad review.

Thank you for the opportunity to comment on this draft. We are hopeful that our comment will be of some small help to you.

Sincerely,

Mary Louise

Mary Louise Hancock
Planning Director

MLH:jyv

Water Supply and Pollution Control Commission
Prescott Park
P.O. Box 95—105 London Road
Concord 03301

June 6, 1972

Mr. David Dupee
New England Div., Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

Dear Mr. Dupee:

Subject: 15 March 1972 Draft Environmental Statement for Newington Generating Station Unit No. 1

In accord with the letter from your office dated 21 April 1972, subject as above, and accompanying the subject publication; this agency wishes to submit these following comments:

page 8 and pages 77-78; No maximum decibel level is stated.

pages 64 and 65; Although the "EPA has recommended that the maximum concentration of chemical biocides not exceed 0.1 ppm at any time--," this agency has agreed to "--discharge of 0.3 ppm maximum chlorine residual--;" because of the high chlorine demand and large volume of the receiving waters, also to establish the fact that the chlorine demand within the system is being satisfied.

pages 68 and 69; The proposed effluent standards for other station wastes are those maxima set forth on page 2 of this agency's "Final Permit to Discharge," issued to Public Service Company of New Hampshire for their Newington Fossil Fuel Electric Generating Station, and dated 13 October 1971.

pages 74 and 75; Is there no way the domestic sewage from the proposed plant may be picked up by the City of Portsmouth or Pease Air Force Base, rather than be treated on site.

page 79; Culverting of streams requires a permit from the Special Review Board and under RSA 149:8-a and should be considered under Dredge & Fill on pages 55 and 56.

pages 82 through 90; The on-going ecology and water quality monitoring program is a requirement on page 3 of this agency's Permit to Discharge dated 13 October 1971, and mentioned above.

This comment is also applicable to the last sentence on page 99.

Aside from these comments, those who read the report felt that it was most complete, and well and objectively done.

Very truly yours,

Ronald E. Towne

R. E. Towne
Biologist

RET/mad

The State of New Hampshire

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Air Pollution Control Commission
61 South Spring Street
Concord
03301

FORREST H. BUMFORD
TECHNICAL SECRETARY

April 26, 1972

Mr. John William Leslie
Chief, Engineering Division
Department of the Army
New England Div., Corps of Engineers
424 Trapelo Road
Waltham, Mass. 02154

Dear Mr. Leslie:

We have reviewed the draft environmental statement for Newington Generation Station Unit No. 1, Newington, New Hampshire, with respect to air pollution potential as well as applicable rules and regulations and will make the following comments and suggestions.

First, it must be understood that the maximum sulfur content of the oil be one percent. Any increase will have a significant effect on the air quality in that given area.

Second, reference was made to air quality studies for ground level concentrations of SO_x, NO_x and particulate matter. A comparison was made between calculated concentrations and observed concentrations. The Agency is not aware as to the nature of such sampling, the time period of this sampling, and the parties involved in this sampling. For verification purposes, the Agency would appreciate receiving this data.

Furthermore, results of preliminary studies indicate that the ground level concentrations for the above pollutants will be less than the air quality standards for the state. Combined emissions from Schiller and Newington Stations indicate again that the standards will be achieved. However, there does not appear to be any indication as to the percentage contribution of each respective source to the air quality. Other major sources are located in this area and must be considered in evaluation of the overall air quality. Again, the Agency would like to be informed as to the method of determination of such air quality levels.

Since the FAA has placed a limitation on the stack height of this installation and because of its proximity to Pease Air Force Base, there has been no reference made to any possible visibility effects in this area and implications that may arise to aircraft travel.

Mr. John William Leslie
Page 2
April 26, 1972

Finally, the Newington sources must comply with all New Hampshire regulations, especially Regulation No. 16, Permit System.

I hope these comments and suggestions are of value to your final statements. If I can be of further assistance, please advise.

Sincerely,

Forrest H. Bumford, P.E.
Director
Air Pollution Control Agency

DRL:cg

cc: Dennis R. Lunderville
Public Service Company
Office of Attorney General

Air Pollution Control Commission
61 South Spring Street
Concord
03301

FORREST H. BUMFORD
TECHNICAL SECRETARY

July 12, 1972

Mr. Gilbert Chase
Dept. of Army
New England Div. Corps of Engineers
424 Trapelo Road
Waltham, Mass. 02154

Dear Mr. Chase:

Confirming our telephone conversation we did manage to find the letter from the Public Service Company of New Hampshire relative to our comments on the environmental impact for the Newington Generating Station No. 1.

We agree with them but do have some reservations concerning the predicted levels of sulfur dioxide, as we do not feel that sufficient monitoring stations have been set up in this state to give us enough information for our computers.

We are in the process now of an extensive statewide network and within another year we will have quite a lot of data on sulfur dioxide, oxides of nitrogen and particulate emissions.

Generally speaking, however, they seem to have answered most of the questions which we raised.

Very truly yours,

Forrest H. Bumford, P.E.
Director
Air Pollution Control Agency

FHB:cg

PUBLIC UTILITIES COMMISSION
26 PLEASANT STREET
CONCORD
03301

TELEPHONE AREA CODE 603
271-2452

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RATE ENGINEER

ALEXANDER J. KALINSKI
CHAIRMAN

June 6, 1972

John Wm. Leslie, Chief, Engineering Division
Department of the Army
New England Division, Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

Attention: NEDED-R
Newington Generating Station

Dear Sir:

In reply to your letter of April 21, 1972, the only comment this Commission has to make in the area of our jurisdiction is that the Newington Generating Station is vitally necessary to meet the load forecast at the time of the station's projected completion.

To that end we would encourage the Department of the Army to complete its studies promptly and issue the necessary permits on a timely basis, so as to permit completion, with whatever modifications may be necessary, in a manner that will have no adverse affect on the public with respect to the availability of adequate electrical energy.

Very truly yours,

N. H. PUBLIC UTILITIES COMMISSION

Alexander J. Kalinski

Alexander J. Kalinski
Chairman

AJK:RR

NEW ENGLAND RIVER BASINS COMMISSION

NERBC

55 COURT STREET • BOSTON, MASSACHUSETTS 02108
PHONE (617) 223-6244

May 1, 1972

Mr. John Wm. Leslie
Department of the Army
New England Division, Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

Dear Mr. Leslie:

In accordance with your request, dated 21 April 1972, the draft environmental statement for Newington cycling plant has been reviewed. The review has been limited to features on which we have had special interests such as our Seabrook Report. Comments are as follows:

1. The Public Service Company of New Hampshire originally planned for the Seabrook Nuclear Plant to be constructed on this site. The nuclear plant was moved during the site planning primarily because of severe design requirements of the FAA for structures in the vicinity of glidepaths of runways of the Pease Air Force base. It is noted that the cycling plant would have a stack 410 feet high. In the environmental statement there should be some consideration of the environmental effects of the stack on the operations of the airbase and safety hazard involved.

2. Recommendation No. 1 of the Seabrook Report states that "Public agencies considering licensing and operating requirements should take into account not only the environmental effects of the first unit when issuing licenses and permits for that unit, but also environmental effects of the ultimate construction. Otherwise, design precedents could be set which could preclude optimum protection of environmental values affected by additional units."

In the draft statement for Newington no mention is made of a second unit or potential units at the Rollins Farm site and at Schiller Station, all of which would utilize the same waterway for cooling water. According to the report: Planning for the Year 2000, published by the Public Service Company of New Hampshire, a second unit of 600 Mw could be added at Newington, and a 2000 Mw development could take place at Rollins Farm. No mention is made in the report of other development at Schiller Station, however, there may be such possibilities. With an ultimate development of 71/2 times (or more) the initial unit capacity, at least some consideration should be given ultimate environmental effects in the draft statement.

Sincerely yours,

Robert S. Restall

Robert S. Restall
Senior Staff Associate

RSR/mph

NEW ENGLAND ENERGY POLICY STAFF
SIX BEACON STREET - SUITE 200
BOSTON, MASSACHUSETTS 02108
Telephone (617) 742-7540

Paul H. Shore
Executive Director

June 22, 1972

Mr. John W. Leslie
Chief, Engineering Division
New England Division, Corps of Engineers
424 Trapelo Road
Walthan, Mass. 02154

Reference: Newington

Dear Sir:

We have had the opportunity to consider further the draft environmental impact statement for the Newington Generation Station. We responded originally in our letter dated May 26, 1972 (copy enclosed), and would like to amend that letter with the following additional comments.

In the draft environmental statement attention was directed to the physical plant of the generation facility. Our additional comments concern the fuel delivery and handling operations. We see no mention of the ship handling other than "increase of potential and spillage due to increased oil tanker service required" in the last paragraph on page 1. What concerns us is that, if the intent of NEPA is to consider the total operation of a facility, should not the fuel handling be considered as an integral part also?

The NEEPS is not intimately familiar with all operations of ship handling. We observe, however, a narrow channel approximately 5 miles long within a large estuary system. The channel above the Schiller Stations appears to be adequate to turn a large tanker around only at a slack tide and only with the help of several tugs. The concrete wharf next to the Schiller Station would seem adequate for only smaller tankers. If the oil is brought in in the smaller, more maneuverable tankers, the large number of fuel transfer operations as well as the increase in number of tankers may create problems. If the tanker size is increased to the larger tankers are the probabilities of groundings due to the short inter-tidal movement period serious? What protection against spills will be used during high volume fuel discharges? Can the larger

To J.W. Leslie (NEDED-R) (contd.) 6/22/72
C/E Waltham, MA

tankers be maneuvered safely in such a narrow channel? Where will the fuel be stored for the new facility?

The continuous pollution from oil spills has effected the Chelsea Creek area in Massachusetts so that the ground is essentially coated with oil below the high tide line from petroleum tanker handling and discharge operations. What steps are being proposed to prevent this type of damage to the area around the fuel unloading facility for the Newington plant? The possible affected drainage include the Piscataqua River estuary including Great Bay, Oyster River, Portsmouth harbor and all the smaller creeks that border on this tidelands system.

These are some of the questions that we feel are pertinent to a complete analysis of this project. The generating station should not be separated from its operation. Much of the potential environmental impact involves the fuel supply part of the operation. NEEPS is concerned basically that this has been not been covered adequately in the Environmental Impact Statement. Please add this item to those in our May 26 letter.

Sincerely,

C. A. MacArthur

Charles MacArthur
Deputy Director

NEW ENGLAND ENERGY POLICY STAFF

SIX BEACON STREET - SUITE 200
BOSTON, MASSACHUSETTS 02108
Telephone (617) 742-7540

Paul H. Shore
Executive Director

May 26, 1972

(NEDED-R)

Mr. John Wm. Leslie
Chief, Engineering Division
New England Division
Corps of Engineers
424 Trapelo Road
Waltham, Mass. 02154

Dear Mr. Leslie:

Your letter of April 21, transmitting a copy of Draft Environmental Statement for the Newington Generation Station to Mr. Richard Wright, Executive Director of the New England Regional Commission, has been referred to us for reply.

Our comments are divided into two groups - those related to the physical plant and its significance in the regional power supply, and those related to environmental questions that are really beyond our areas of expertise but that nonetheless seem pertinent.

Comments in the first group are:

1. On page 2, line 2, we suggest changing the statement to "and a maximum heat rejection rate of 2.2 x 10^9 Btu/hour", to warn the reader that this is not a constant rejection rate. The difference between average and maximum thermal effects is particularly significant for a cycling plant such as the one proposed here. The discussion on pages 52 and 53 is based on maximum output and shows a long-term temperature rise of 0.97°F. Similar figures should be provided to show the effects of "normal" (i.e., 16 hrs/da) operation on the temperature rise in the estuary. Certainly the Statement should analyze the worst possible situation, which it does, but we think it should also show what conditions could be expected under the planned operating patterns.

To J.W.Leslie(NEDED-R) (contd) 5/26/72
C/E Waltham, MA

2. In the early years of operation this plant will probably be in use more than the 16 hours per day on weekdays mentioned on page 2 in section 1, B, b "Planned Operation". A load factor of 75 percent requires at least 125 hours operation per week. This will affect the amount of heat rejected to the river, as discussed above, but the cumulative rejection will still be well below the maximum possible.

3. The selection of a cycling unit is proper, considering system demand patterns and other available and planned generation. In the early years the Newington unit will run more than normal for such a unit. However, within a few years, when more base load generation is installed, the hours of operation will decrease and the unit will function more in the range for which it is most economical. This changing pattern of operation is consistent with economical system development and is quite common.

4. The power supply for New England in the winter of 1974 will be adequate if all units presently under construction and scheduled to be in service before December 1974 actually are in service. The major units scheduled for service in the balance of 1972 and in 1973 are expected to be on line before December 1974. The units listed below currently are scheduled for service in 1974:

Millstone No. 2	nuclear	830 MW	April
Bear Swamp No. 1	pumped storage	300 MW	May
Newington No. 1	fossil-oil	420 MW	June
Bear Swamp No. 2	pumped storage	300 MW	July
Brayton Point No. 4	fossil-oil	465 MW	Nov.

Of these, the Brayton Point unit will most likely be delayed due to cooling water discharge difficulties that have already required major changes in the plant arrangement. The Millstone unit is progressing satisfactorily and should be on-line in time for the winter peak unless some major problems are brought to light in the final operating permit hearings. Since this is a second unit at an existing site, the probabilities of delay are lower than for a first unit. There is presently no indication Bear Swamp will be late by any significant amount.

Thus it appears that the December 1974 capacity should be only 465 megawatts below that currently scheduled. This provides an installed reserve of 26 percent, which is adequate. If the Newington unit should slip more than six months, the 1974-75 winter reserves would be reduced to 23.5 percent, an amount that is acceptable unless some of the other units listed above also slip. If any units in addition to Brayton Point and Newington fail to meet the November 1974 deadline, the reserves available would be considered inadequate.

To J.W.Leslie (NEDED-R) (contd) 5/26/72
C/E Waltham, MA

The second group of comments that follow raise questions which we feel should be considered by others.

1. Under section 1G "Aesthetics Appearance" the applicant mentions landscaping. In section 1A "Site" the landscaping is combined with "natural succession". Care should be taken to screen the plant and the switchyards from Dover Point Road, Woodbury Avenue, and Spaulding Turnpike with attractive trees and shrubs, not trash growth that could result from "natural succession".

2. In section 1Cb, page 4, "Intake", it states the washings from the screens will be returned to the estuary. It would seem prudent to screen out any floating debris for proper disposal ashore.

3. In section 2 "Environmental Setting Without the Project" (page 11), there is mention of a slow reestablishment of the eel grass after a 40-year absence. Can the effect of increased temperature on this process be foretold?

4. In the same section (page 17), there is mention of domestic sewage from adjacent communities. Such discharge should be stopped, and the Newington plant sewage disposal should be carefully controlled, as mentioned on page 75. Under such conditions, water quality might not be a limiting factor for swimming.

We appreciate the opportunity to review the statement.

Sincerely,

Paul H. Shore

Paul H. Shore
Executive Director

cc: New England Regional Commission

Normandeau Associates, Inc.

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ONALD A. NORMANDEAU, PH.D.
IHN D. DAVIS, PH.D.

June 2, 1972

Mr. John Wm. Leslie
Chief, Engineering Division
Department of the Army
New England Division
Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

Subject: Piscataqua River - Newington Generating Station Environmental Impact Statement

Dear Mr. Leslie:

We are in receipt of your department's draft report on the Newington Generating Station Unit No. 1, Newington, New Hampshire, and would like to offer some additional information regarding certain comments on our initial report. The comments presented in the Newington Environmental Statement were apparently based on information developed during the 1970 Piscataqua River Ecological Study. This was essentially an inventory phase. A comprehensive ecological monitoring and baseline study was initated in the spring of 1971. A draft report on these studies is enclosed for your information. Unfortunately, the various study programs conducted during the 1971 and early 1972 period were not available for incorporation into the Newington Environmental Statement. Therefore, certain comments in the statement reflect a lack of knowledge of the existing program.

In the review of the Newington Environmental Statement, we have found certain statements which we believe, based on more recently available information, should be changed. In particular we refer to concern expressed in pages 83 through 100 over sampling frequencies used in some of our biological and physical programs, and an apparent lack of recognition for others, for instance primary productivity. Each of these areas will be discussed in a topical fashion in the following paragraphs, reference being made to specific passages in your report which bear on each.

1. Thermal blockage of the constricted portion of the river at Boiling Rock, and the need for more intensive studies in the immediate Newington Station discharge area - (ref. p. 83, Para. 1; p. 84, Para. 1; p. 87, Para. 2):

As a matter of record Station 3 is 1,500 feet directly off of, and not upstream, of the proposed discharge. This station is in the channel. However, we do intend to augment our temperature monitoring in this area, as well as in the vicinity of Station 15, which is where the river becomes more constricted. The reason we feel that thermal additions will have little impact upon the existing biota is not that the river exhibits wide natural temperature variability, but that considerable mixing occurs in those portions of the river which will receive this discharge. These feelings were borne out in our 1971 monitoring program, which was quite comprehensive.

2. Entrainment of zooplankton, especially such meroplankton as fish eggs and larvae and bivalve larvae - (ref. p. 83, Para. 1; p. 84, Para. 2; p. 88, Paras. 1 and 2):

Species composition and diversity of zooplankton and phytoplankton communities are being monitored at Station 3 on a monthly basis with replicate samples at surface and 8 meter depths on both ebb and flood tides. Also, fish eggs and larvae are sampled on a biweekly basis using coarse mesh meter nets. Each of these programs has been or will be increased this year. A new plankton station has been established at the Newington intake facility, and meter nets will be used in this area on an intensive exploratory basis to determine spatial and temporal distribution of fish eggs and larvae.

3. Primary productivity - (ref. p. 100, Para. 2):

This parameter was measured monthly in 1971, and a similar monitoring program is underway this year. Whereas the 1971 production rates were determined by oxygen uptake, future assessments will be according to the C^{14} method.

4. Sport fisheries, particularly migratory and anadromous species (ref. p. 84, Para. 3; p. 85, Para. 2; p. 86, Para. 2):

We have at present, as we had in 1971, an extensive fisheries program underway. This includes seining and trawling (replicate monthly hauls at several stations over the course of the river), sonic tagging of striped bass and coho salmon, and creel census for striped bass and rainbow smelt. Each of these programs has been set up to facilitate statistical comparison from year to year, and the seining effort will be further augmented this year in the Newington area. The sonic tagging program was quite successful and in 1971 was limited only by our ability to obtain specimens. This year we have gained permission to utilize gill nets in capturing fish, and should be able to tag many more individuals. With respect to population dynamics, we do not feel that these sorts of statistics are accessible without a vastly increased effort, particularly so for migratory species. Furthermore, it is our opinion that the results obtained from such an increase would be of questionable value.

5. Others (ref. p. 89):

Studies were implemented in 1971 on intertidal organisms, benthos, epibenthos, plants, and oysters. The intertidal program encompasses both muddy and rocky habitats (mostly in the Newington vicinity). Both intertidal and benthic studies utilize replicate sampling (10 quadrats/station and 5 grabs/station, respectively), and statistical analyses for each are extensive. Oyster studies comprise growth rates, mortality rates, and spat settlement.

We hope the above study descriptions, although brief, will prove useful to your organization in evaluating Public Service Company of New Hampshire's Newington Generating Station in composing a final impact statement. If you have any further questions regarding these matters please do not hesitate to contact us.

Yours very truly,

NORMANDEAU ASSOCIATES, INC.

Donald A. Normandeau

Donald A. Normandeau, Ph. D.
President

DAN:sdh

Enclosure (Draft Report - 1971-72)

cc: Mr. Henry J. Ellis
Mr. Bruce Smith
Dr. Lawrence Frederick

jackson & moreland

division of United Engineers & Constructors Inc.

600 Park Square Building, Boston, Mass. 02116 • Telephone 617-482-8100

June 6, 1972

Department of the Army
New England Division, Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

Attention: Mr. John W. Leslie
Chief, Engineering Division

Subject: Public Service Company of New Hampshire
Newington Station Unit No. 1
Draft, Environmental Statement

Gentlemen:

We have reviewed the Draft Environmental Statement prepared and issued relative to the Newington Station of Public Service Company of New Hampshire, and have several comments, as follows:

1. Under Paragraph 3a. Environmental Impacts, on the Summary Sheet, the statement regarding discharge of domestic sewage and other station wastes is somewhat misleading when compared to the detailed description of station waste treatment on pages 67 through 75.

2. On page 74, reference is made to Sacrificial Anodic Devices, and limited application of zinc in the Newington Station circulating water system. Whereas this was true when Public Service Company of New Hampshire first prepared the input material for the Draft, subsequent design modifications have eliminated the use of zinc anodes.

3. On page 54, we are unable to verify the Paragraph which states:

> "At the edge of the mixing zone the temperature of the water at any depth shall not exceed 82F at any time. The temperature of the bottom waters at the edge of the mixing zone shall not exceed 77F for more than an aggregate of 8 hours for any 24 hour period and shall not exceed 79F at any time".

Department of the Army .... 2 June 6, 1972

4. On page 1, Project Description, it is stated that a straight section of river of fairly uniform cross section extends from about 1500 feet downstream of the site to about a mile upstream, while on page 86 it states that the river narrows considerably immediately downstream of the discharge in the vicinity of Boiling Rock. This seeming inconsistency brough forth questions from our reviewers.

We are pleased at the opportunity of reviewing this draft and feel that insofar as the technical aspects of the station design are concerned, it represents an accurate presentation.

Very truly yours,

JACKSON & MORELAND DIVISION

P F Gorman NEB

P. F. Gorman
Vice President

PFG:NEB:sat
R. N. 5389-00
cc: Mr. H. J. Ellis (4)
Mr. W. F. Emerson (1)

PUBLIC SERVICE Company of New Hampshire 1000 Elm Street, Manchester, N. H. 03105

June 8, 1972

Colonel Frank P. Bane, Division Engineer
Department of the Army
N. E. Division Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

Subject: Newington Station Unit #1
Review of Draft Environmental Statement
Prepared by the New England Division, Corps of Engineers

Dear Colonel Bane:

Our comments on the Draft Environmental Statement for Newington Station Unit #1, prepared in your offices, are attached. We have pointed out minor errors in spelling, grammar and phraseology which we hope will help to expedite the preparation of the Final Statement. In addition, we have indicated several areas where we believe clarification is desirable. We would be pleased to review these particular areas with your staff.

Our major concern is to obtain the necessary permits to allow for scheduled completion of this extremely important generating facility. As expressed to you several months ago, we stand ready to assist you in any way to help expedite the preparation of the Final Environmental Statement.

Very truly yours,

Eliot Priest
Eliot Priest
Vice President

EP:JHH:dpz

COMMENTS ON U.S. CORPS OF ENGINEERS - DRAFT ENVIRONMENTAL STATEMENT
FOR NEWINGTON STATION UNIT #1
BY PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE

#1

Our understanding of the "Engineer Regulations on Preparation and Coordination of Environmental Statements", Federal Register, Volume 37, No. 22 dated February 2,1972 is that a sentence must be included indicating that the National Register of Historic Places has been consulted and that no National Register properties will be affected by the project. No such sentence is presently included.

#2 - Lead Photo

We bring to your attention the flag indicating the name of our existing generating station is misspelled. The correct spelling is "Schiller".

#3 - Summary Sheet, par. 3a

The ecological changes that may result from the discharge of sewage and other station wastes should be qualified in the summary. It leaves the impression that these discharges are untreated and unmonitored. Domestic sewage leaches into the ground after treatment, whereas the other station wastes are monitored, treated as required and released to the River.

#4 - Summary Sheet, par. 3a

In an attempt to preserve land in its natural state only 20 acres will be required for plant operations and 40 acres used during construction of this 54 acre plant site.

#5 - Summary Sheet, par. 3b

We suggest your statement covering the possibility of a thermal blockage should mention that the analytical predictions of plume extent show this will not occur.

#6 - Summary Sheet, par. 3b

In the next to the last sentence in this paragraph "adjacent" is misspelled.

#7 - Introduction, par. 3

Studies are being conducted on a continuing basis, however, physiological studies of various species, not specifically related to the Piscataqua estuary are basic research and beyond the scope of monitoring studies. ?

#8 - Introduction, par. 4

Public Service Company of New Hampshire desires an opportunity to review and comment on any additions to the monitoring program before these are incorporated into the final statement and become conditions of any permits.

#9 - Figure 1

See comment #2, "Schiller" is mispelled.

#10 - pg. 6, par. d

12,000 cy of sand and gravel will be excavated not 1,200 cy.

#11 - pg. 13, par. 1

A verb is omitted, possibly "include" should be inserted after abutters.

#12 - pg. 14, par. 2

"Discrete" is misspelled.

#13 - pg. 19, par. 1

The water exchange rate is approximately 9,000 cfs for the area near the Rollins Farm Site in Newington. The Rollins Farm Site is approximately 1.2 miles upstream from the Newington Station Site. The water exchange rates are approximately 15,500 cfs at Newington Station and 17,600 cfs at Schiller Station.

#14 - pg. 19, par. 1

"Accelerated" is misspelled.

#15 - pg. 20, par. 2

"Loses" is misspelled.

#16 - pg. 27, par. 2

The parenthetical note (Figures 55-64) are not included and therefore the note should be omitted.

#17 - pg. 30, par. 3

The noted reference (Figure ?) should be filled in or omitted.

#18 - pg. 32, par. 2

We believe the word "smaller" should be used in the following sentence and not "larger" "...and quite likely some of the smaller phytoplanktonic chains..."

#19 - pg. 41, par. 1

"of" is misspelled.

#20 - pg. 42, par. 1

"Amphipods" and "Polychaetes" are misspelled.

#21 - pg. 52, par. 2

The phrase in the last line on this page "...or defined by the applicant miles..." is not understood. Please clarify.

#22 - pg. 54, par. 1 and 2

PSNH is unaware of the promulgation of the F.W.Q.A. standards stated as follows and questions their applicability to the Newington project, starting at: "The temperature at no time shall be..." and continuing to the end of the second paragraph.

#23 - pg. 57, par. 1

We suggest that potential physical damage from passage through the circulating water pumps etc. may result in some destruction and damage.

#24 - pg. 60, par. 1

The screen wash sluice trough, coupled with the local current patterns is designed to minimize the reintake of all material intercepted by the screens including planktonic life forms and it will not distribute this material into the discharge flume. The design of returning this material to the estuary is based upon satisfactory experience gained at Schiller Station.

#25 - pg. 60, par. 2

This entire paragraph is difficult to understand, possibly an entire thought was omitted during typing.

#26 - pg. 61, par. 3

Clarity would be improved by adding Schiller Station ahead of Unit No. 4 at least for the initial use of the unit number.

#27 - pg. 63, par. 4

"When" should be replaced by "where".

#28 - pg. 65, par. 2

PSNH's experience with continuous low residual chlorination at Schiller Station was described to you in item #4 of our letter to the Corps of Engineers dated November 16, 1971. We believe this experience is much more germane to any environmental impact and biofouling problems than your reference to the Canal Station.

#29 - pg. 70, par. 1

The word "or" should be "of" in the phrase "...boiler or the type..."

#30 - pg. 73, par. 1

The seven monthly samples referenced (February through August) should include the year 1971 for clarity.

#31 - pg. 74, Table

Item 11 - Sacrificial Anodic Devices have been eliminated from the Newington Design.

#32 - pg. 85, par. 3

Your reference to the trapping of striped bass in water intakes is questioned. Our experience at Schiller Station with approximately 75 unit years of operation has been negative in regards to trapping striped bass in the condenser cooling water intakes.

#33 - pg. 86, par. 2

Table IV is found on Page 23, not Page 22.

#34 - pg. 87, par. 1

We find no evidence in the report to support your initial phrase in the first whole sentence "In addition to thermal blockage and insufficient oxygen,".

#35 - pg. 87, par. 2

Public Service Company of New Hampshire does not think that the assumptions stated in this paragraph are valid nor merit more refined studies prior to the issuance of the permits requested. Positive predictions have been made by the Applicant and his consultant.

#36 - pg. 88, par. 1

Zooplankton is mistyped as 200 plankton.

#37 - pg. 88, par. 1

"Larvae" is misspelled as "larval" in two places.

#38 - pg. 88, par. 2

The page reference in parentheses should be 84, not 82.

#39 - pg. 99, par. 2

The statement about extreme temperatures rendering a near sterile bottom condition in the discharge flume is not applicable to Newington Station Unit #1. A rise in the ambient temperature of the waters of the Piscataqua River of 20°F is in our opinion not extreme, and our observations at Schiller Station show it will increase the sessile growth in the flume.

#40 - pg. 101, par. 3

Please explain why fish are not replaceable by natural recruitment and capable of sustaining the described impacts.

JHH

MAINE HISTORIC PRESERVATION COMMISSION
31 WESTERN AVENUE
AUGUSTA, MAINE 04330

MUNDY
TOR

AREA CODE 207
289-2133

August 29, 1972

Mr. H. J. Ellis
Director of Engineering
Public Service Company of New Hampshire
1000 Elm Street
Manchester, N. H. 03105

Dear Mr. Ellis:

In regard to your letter of August 9, 1972 concerning the construction of Newington Station Unit #1; I can only say that given the information available to me at this time I can see no unfavorable impact on any National Register or potential National Register site in Maine.

Sincerely yours,

J. H. Mundy

J. H. Mundy
State Liaison Officer

JHM/bss

STATE OF NEW HAMPSHIRE

DEPARTMENT of RESOURCES and ECONOMIC DEVELOPMENT

P. O. BOX 856 ··· STATE HOUSE ANNEX ··· CONCORD, NEW HAMPSHIRE ··· 03301

Office of the Commissioner

October 3, 1972

Mr. H. J. Ellis
Director of Engineering
Public Service Company of
New Hampshire
1000 Elm Street
Manchester, New Hampshire 03105

Dear Mr. Ellis:

In regard to your request of August 9, 1972, it has been established that the Newington Station Unit #1, Newington, New Hampshire, will not adversely affect properties currently listed or under consideration for the National Register.

Very truly yours,

George Gilman
Commissioner

MJ